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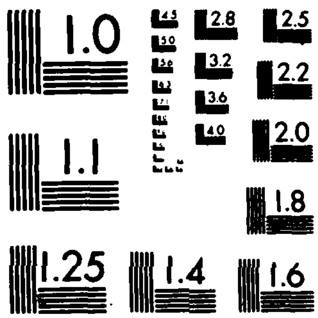

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Special Report D-82-2

LOGAM
USERS MANUAL
VOLUME II

Systems Analysis Division
Systems Analysis and Evaluation Office
US Army Missile Command
Redstone Arsenal, Alabama 35898

August 1982

U.S. ARMY MISSILE COMMAND
Redstone Arsenal, Alabama 35898

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LOGAM

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FORWARD

The Logistic Analysis Model LOGAM Users Manual Volume II was written under Contract DAAH01-82-P-0886. The work was performed with the US Army Missile Command under the general technical cognizance of Mr. Raymon S. Dotson, Systems Analysis Division, Systems Analysis and Evaluation Office, US Army Missile Command, Redstone Arsenal, Alabama. The program also produced two companion documents entitled Executive Summary Volume I and Technical/Programmer Manual Volume III.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This manual describes the Logistic Analysis Model (LOGAM) and its use for evaluating logistic operations as applied to US Army materiel systems. The objective is to develop methodology for generating quantitative data for analysis of activities necessary to equip, operate, maintain, and support a materiel system. LOGAM is a deterministic model, analytical in design through its sensitivity feature, and highly versatile in its ability to evaluate many alternatives rapidly and inexpensively. Through the sensitivity median,

ABSTRACT (Continued)

ABSTRACT (Concluded)

support alternatives are tested for evaluating life cycle costs and for recommending optimum repair levels; repair versus discard at failure; manpower, provisioning and test equipment requirements; table of organization and equipment adjustment or development; and other operational elements by quantities and costs.

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SECTION 1

INTRODUCTION

Like its predecessor LOgistic Cost Analysis Model (LOCAM), the LOGistic Analysis Model (LOGAM) provides a unique tool for the evaluation of alternate support postures for Army equipment. Tradeoffs are made on the basis of cost and availability. Enhancements to LOGAM include the addition of four additional maintenance policies which permit LRU repair at the equipment level. LOGAM also provides the ability to include operational costs for a particular theater of operations and these should be based on the TOE for the theater under consideration. The operational cost definitions are based on DA Pamphlet 11-4 "Operating and Support Cost Guide for Army Material Systems", April 1976. As with other tools of this type, the validity and usefulness of the analyses performed are to a great degree dependent of the skill of the analyst in its application.

The LOGAM program is specifically structured to perform logistic analyses in maintenance support and operational situations for a diversity of operating equipments. The manner in which maintenance support is handled in LOGAM follows a similar methodology to the previous LOCAM 5 model. The technique for accommodating the operational aspects is discussed in Appendix C.

In using the program, the analyst may structure his input data as a sequence of installed equipments (LRUs) which require support. The program processes each LRU sequentially. Provision is made within the program to store cumulative demand for work at common test and repair facilities over several different LRU's. The input process groups the LRU's which share such common facilities and when the last LRU in the group is reached, the costs for the support channels are computed based on the total work load in the accumulators. The accumulators are then reset and the next group of LRU's may be processed. An alternate approach may be to process each LRU separately so that total support costs are obtained for each LRU on an individual basis. Finally inputs related to operational factors are added in an array format. These inputs relate to costs for operational personnel not involved in maintenance, POL, operational training, crew costs, replacement costs for crew and indirect personnel, quarters, medical support, etc.

Five types of support channels may be modeled, simultaneously and asynchronously, with respect to the input sequence of equipments. In the terminology of the program, these are as follows:

a) Automatic Test Equipment Support (Field or Depot).
b) Special Depot Test Equipment.
c) Calibration Sets in the Field.
d) Contract Support Teams and Test Sets.
e) Built in Test Equipment

Section 5.1 further explains these support channels and the variety of costs included in the computations.

Section 4 describes the unique sensitivity testing feature of the model whereby inputs can be varied through a range of values during any set of computer runs.

The LOGAM Programmer/Technical Manual Vol. III is devoted to detailed descriptions of the technical aspects of the model. These include program structure, program flow, principal mathematical formulations, program listing, and those aspects related to the preparation of the input data base.

Symbols and input definitions are contained in Appendices A and B. An application of the model is discussed in Appendix C to acquaint potential users with the operation of LOGAM. An explanation of the theory and rationale associated with the application procedure is also included. Appendix C addresses the prediction of logistic support costs for a land combat missile system. Although derived from a hypothetical data base, the deployment is representative of actual US Army missile deployments overseas and continental United States scenarios.* The example includes the use of special features describing realistic Army maintenance rules. Thus potential users, after compilation of the LOGAM program on their computer, can follow the procedure outlined in this manual as the initial step in becoming proficient in the use and operation of the program.

*NOTE: When operational costs are also computed, the model is restricted to a single theater of operations. Multiple theaters can be accommodated by successive computer runs.

SECTION 2

LOGAM DESCRIPTION AND VERSATILITY

LOGAM is a computerized mathematical model for evaluating life cycle costs (LCC) and for recommending optimum repair levels, repair versus discard-at-failure, test equipment requirements, and spare provisioning, etc.

As shown in Figure 1, applications of LOGAM involve a systems engineering approach to the evaluation of alternative logistics postures such that the repair of modules/subassemblies of LRUs is facilitated to reduce LCC.

However, when operating and support life cycle costs are the desired output, the evaluation is restricted to a specific TOE and specific maintenance concept for each item of equipment. This latter maintenance concept may be as defined in the Logistics Support Analysis Record (LSAR).

2.1 Description of LOGAM Maintenance Analysis Portion

LOGAM can be used for the purpose of evaluating alternate maintenance postures on the basis of LCC. Although organizational and maintenance (O&M) phase and costs are emphasized, LOGAM also accounts for equipment nonrecurring development costs, the investment in test equipment, facilities, spares, end item equipments replacement subassemblies and parts, as well as the on-going costs of manpower, attrition, transportation and handling, and administration of the support system.

Previous versions of the Logistics Analysis models have found use, not only within the US Army, but are included in the model repetoire of the US Navy (NADC) and the US Air Force (AFLC).

The maintenance analysis portion of LOGAM is driven by those aspects of the equipment characteristics that create flow through the support system such as maintenance incident rate, inverse of mean time between maintenance actions (MTBMA), the fraction of time the system is "on", scrap rate, the false failure of true failure ratio, and attrition. As indicated in Figure 2, this driving force creates demands on the support system, determined in part by the maintainability characteristics as they affect and are affected by test equipment, level of training (and hence manpower costs), and time to repair. The spares (quantity and location) which reflect the effect of the length of the pipe, mission duration, level of repair, and the deployment of facilities are also affected.

The end result is a means of rapidly examining the effects of many basic ways of supporting the end item equipment with variation in stock locations as well, as indicated in Figure 3. In Figure 3 an X indicated that some action occurs as described in the comments around the perimeter of the matrix. Thus, test equipment will be located at Equipment, at Direct Support and at Depot for the maintenance policy

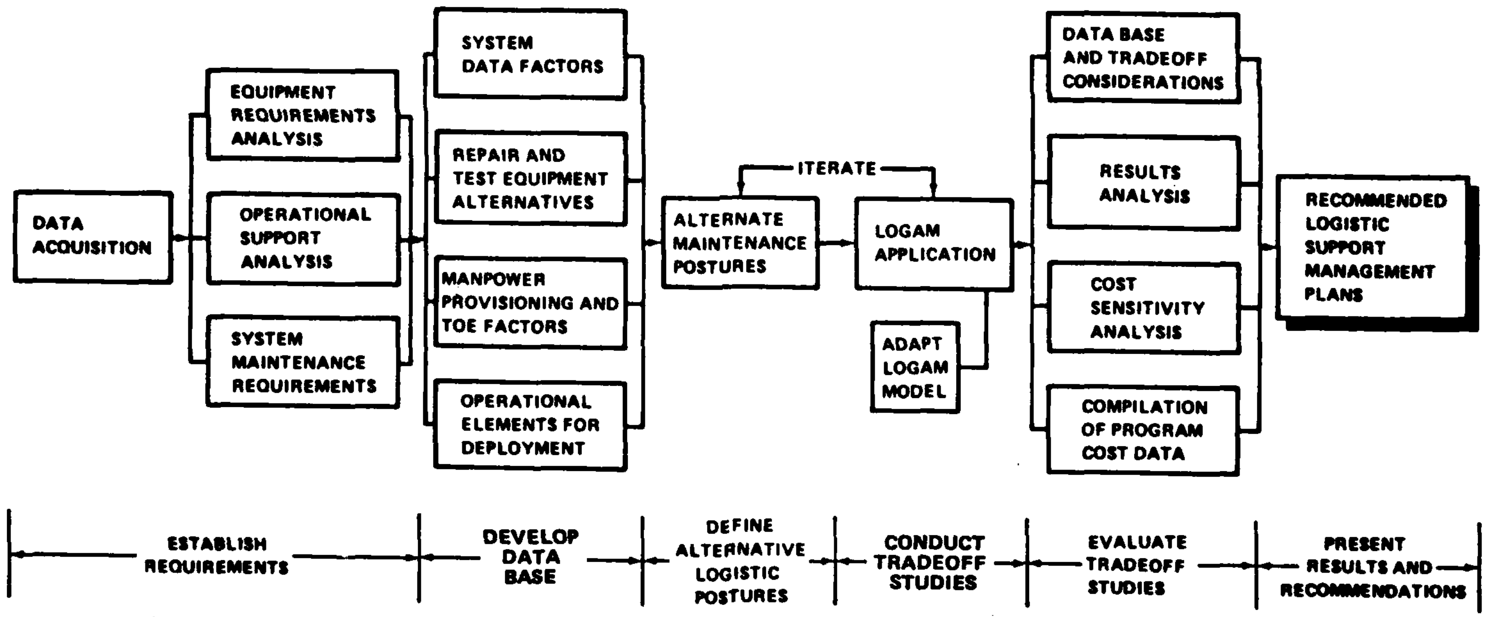


Figure 1. System Engineering Approach To Logistic Evaluation

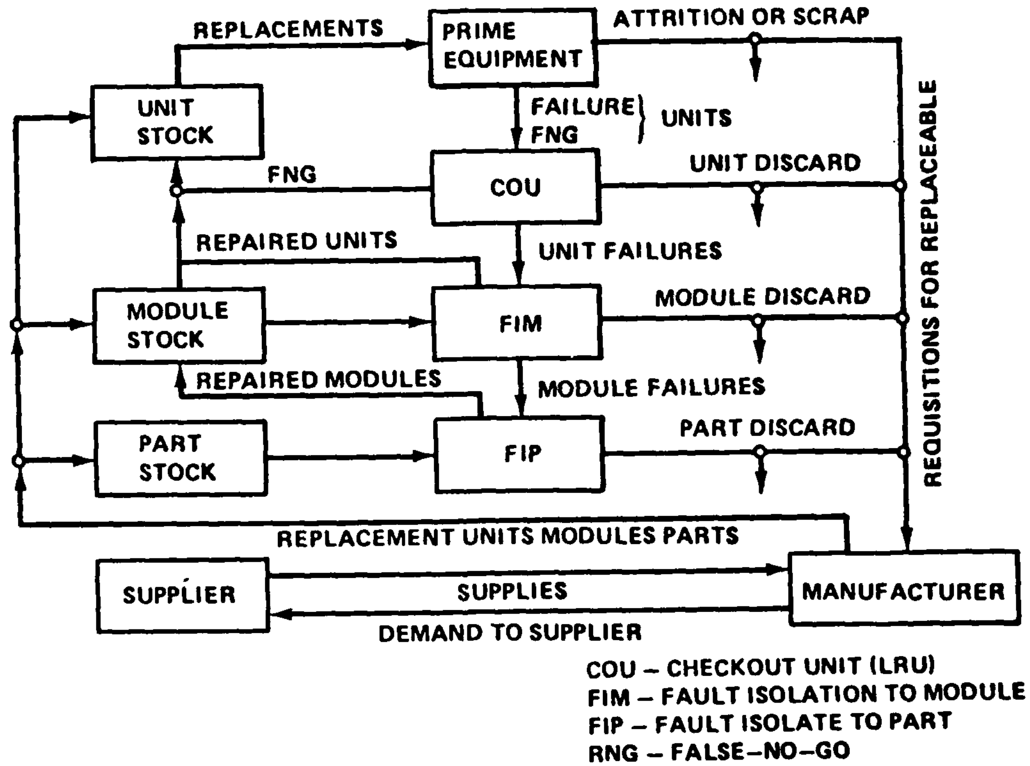


Figure 2. Basic LOGAM Maintenance Repair Flow Framework

TEST EQUIPMENT WILL BE LOCATED AT

FOR THE MAINTENANCE POLICY DESIGNATED BY

TEST EQUIPMENT CAN ISOLATE FAULTS TO THIS LEVEL

Test equipment located at	GA	GB	GC	GD	GE	GF	GG	GH	GI	GJ	GK	GL	GM	GN	GO	GP	GQ	GR	GS	GT	*	Isolate faults to
EQUIPMENT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	TRC	LRU
EQUIPMENT			X						X	X	X										TE TER	MODULE
DIRECT SUPPORT		X		X		X		X	X			X	X	X	X	X	X				TC	LRU
DIRECT SUPPORT				X					X			X	X	X							TF TFR	MODULE
DIRECT SUPPORT									X			X									TMO TMOR	PART
GENERAL SUPPORT					X	X				X			X		X	X		X	X		TC	LRU
GENERAL SUPPORT					X	X				X			X		X	X		X	X		TI TIR	MODULE
GENERAL SUPPORT										X			X		X			X			TMI TMIR	PART
DEPOT							X	X			X			X		X	X		X	X	TC	LRU
DEPOT							X	X			X			X		X	X		X	X	TD TDR	MODULE
DEPOT											X			X		X	X		X	X	TMD TMDR	PART

LRU (GA–GB) MODULE (GC–GI) PART (GJ–GT)

REPAIR WILL BE ACCOMPLISHED BY DISCARDING AND REPLACING THE FAILED.

* LOGAM MNEMONIC

Figure 3. Maintenance Policy Matrix

designated by GH. The test equipment can isolate faults to the level of the failed UNIT/LRU and (at Depot) to the failed MODULE. Additionally, the spare UNITS/LRUs may be located at any of four areas indicated in Figure 3.

Because LOGAM has been developed principally for Army use, Figure 3 uses Army terminology. The support echelons, however, could just as well be representative of an Air Force or Navy hierarchy. In Air Force terms, Direct Support would be Organizational or Base Support, General Support would represent the Air Force Intermediate Level Shops, and Depot would be an Air Logistic Center (ALC). In Naval terminology, Equipment Level would be shipboard which might also contain Organizational Support. Intermediate Support would be supplied by Tender and Depot would represent Shipyard (Table 1). Other inputs could be judiciously selected such that the LOGAM model could apply as well to logistic or LCC studies of the other services.

TABLE 1. SUPPORT ECHELON

LOGAM	ARMY	AIR FORCE	NAVY
EQUIPMENT (E)	ORGANIZATION	EQUIPMENT	EQUIPMENT
FIELD ( )	DIRECT	BASE SUPPORT	SHIP
INTERMEDIATE (I)	GENERAL	INTERMEDIATE LEVEL SHOPS	TENDER
DEPOT (D)	DEPOT	AIR MATERIAL AREA	SHIPYARD

The yardsticks created by LOGAM maintenance calculations are the support costs (investment plus on-going costs for the specified life of the equipment) and inherent availability of each LRU.

The overall approach to a typical LCC support cost effort is presented in Figure 4. First the LCC plan is updated to assure compatibility of Army goals and approaches with the program requirements. This effort is accomplished in conjunction with establishment of interfaces with all sources of information pertinent to the LCC analyses. Through interaction with Army organizations, contractor activities and consultants, the LCC activity identifies specific requirements for analyses to be performed, those cost elements most pertinent to individual subsystems/analyses, and the nature of available/required inputs and required outputs forms. As these requirements take shape, the LOGAM model is adapted to fit the planned analyses. All cost analyses are subject to an iterative process whereby analysis requirements and cost factors are combined. Results of analyses are primarily system effectiveness, Integrated Logistics Support (ILS) planning, and trade-off activities. LCC reports consist

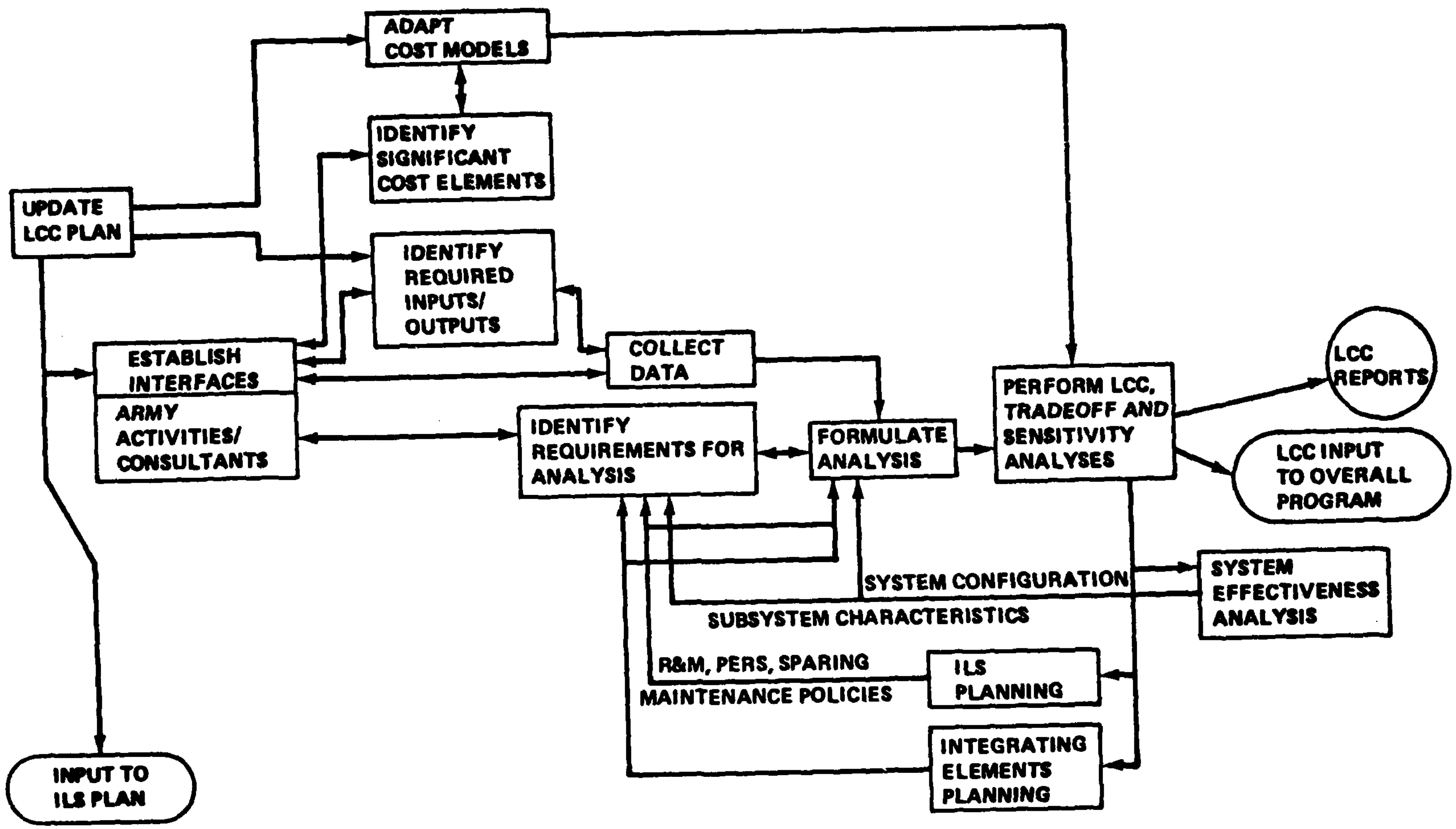


Figure 4. Overall LCC Support Cost Approach

of cost estimates, sensitivity analyses, description of cost methodology, and supporting factors/cost estimating relationships.

In performance of a baseline analysis, data are generated which show LCC and the allocation of these costs by phase, equipment, and effort. In addition, sensitivity analyses show the effect on LCC of varying selected equipment design, operation and support factors. These analyses support design activity decisions and amplify the impact of determined system characterisitcs. Typical candidates for cost sensitivity analysis include equipment MTBMA, production equipment costs, equipment utilization, equipment life, and deployment length.

Prior to the first iteration and between subsequent iterations, the LCC support cost effort is generally engaged in performing tradeoffs of the cost of competing equipment and/or concepts. Minimally this tradeoff activity is envisioned as aiding in the following determinations:

a) The desired degree of standardization.

b) Optimum maintenance manning.

c) Desirability of individual or shared test equipment.

d) Method of maintaining; i.e., level of repair, amount of test equipment justifiable, sparing and provisioning by quantity, and location.

Tradeoffs can be made by changing equipment or concept model input values to reflect the characteristics of the alternative equipments or concepts. Comparison with the baseline results then yields data to justify one approach versus another. These data can be supplied to the cognizant group seeking such justification.

The LOGAM model can be run on any medium or large scale computer with FORTRAN IV capability and sufficient wordlength and memory. Various computation facilities utilized in the past for previous versions of the model have included the following:

a) IBM 7090.
b) IBM 7094.
c) IBM 360.
d) RCA SPECTRA 7045 (UNIVAC).
e) CDC 6600.
f) PRIME.

2.2 LOGAM Modeling Interface

The data base for the maintenance analysis portion of LOGAM should include the following:

a) Delineation of equipment factors.

b) Data generated as the result of operations and equipment analysis.

The synthesis of viable support systems is dependent upon the results of these activities. Alternate support systems which meet the workload demand and consider the application of inventory standard test equipments and general purpose ATE or special support equipment with varying degrees of automation can be considered as tradeoff factors.

Figure 5 illustrates the overall framework within which the support and test equipment tradeoffs can be conducted. As illustrated, application of the LOGAM model to the support or test equipment definition requires consideration of significant factors to be traded off and in specifying meaningful quantitative data as inputs to the mathematical model. These data are generally based on a review of the operational concept, followed by a period of data collection from various sources and data consolidation for use in the analysis.

2.3 LOGAM Maintenance Analysis Applications

LOGAM maintenance analysis can be applied to nearly any equipment at any stage of its life and yield worthwhile benefits. It enables the user to make decisions based on results of the manipulation of many factors. However, the model is particularly useful early in the life of the system. When it is used in the concept phase or early in system design, LOGAM may affect decisions that influence the design of equipment such that optimum support may be realized when the equipment is fielded.

For example, LOGAM provides data and support analyses leading to better decisions in such areas as:

a) What spares should be stocked and where located?

b) How much reliability and maintainability should be designed into the equipment?

c) Should design be based on repair of throwaway and at what level?

d) How many test and repair men are needed at Organization, Direct Support, General Support, and Depot?

Such questions are examined in view of the cost to design, produce, and maintain the equipment.

LOGAM is a flexible and versatile program used to address a variety of questions. In addition to those decision areas mentioned previously, it has been used as follows:

a) To choose from a wide variety of support possibilities. Should the unit be throwaway or repairable? To what level should it be repairable?

b) To study effects of pipeline lengths and transportation costs. Is it possible that faster, more expensive transport is better in the long run than slower, cheaper means?

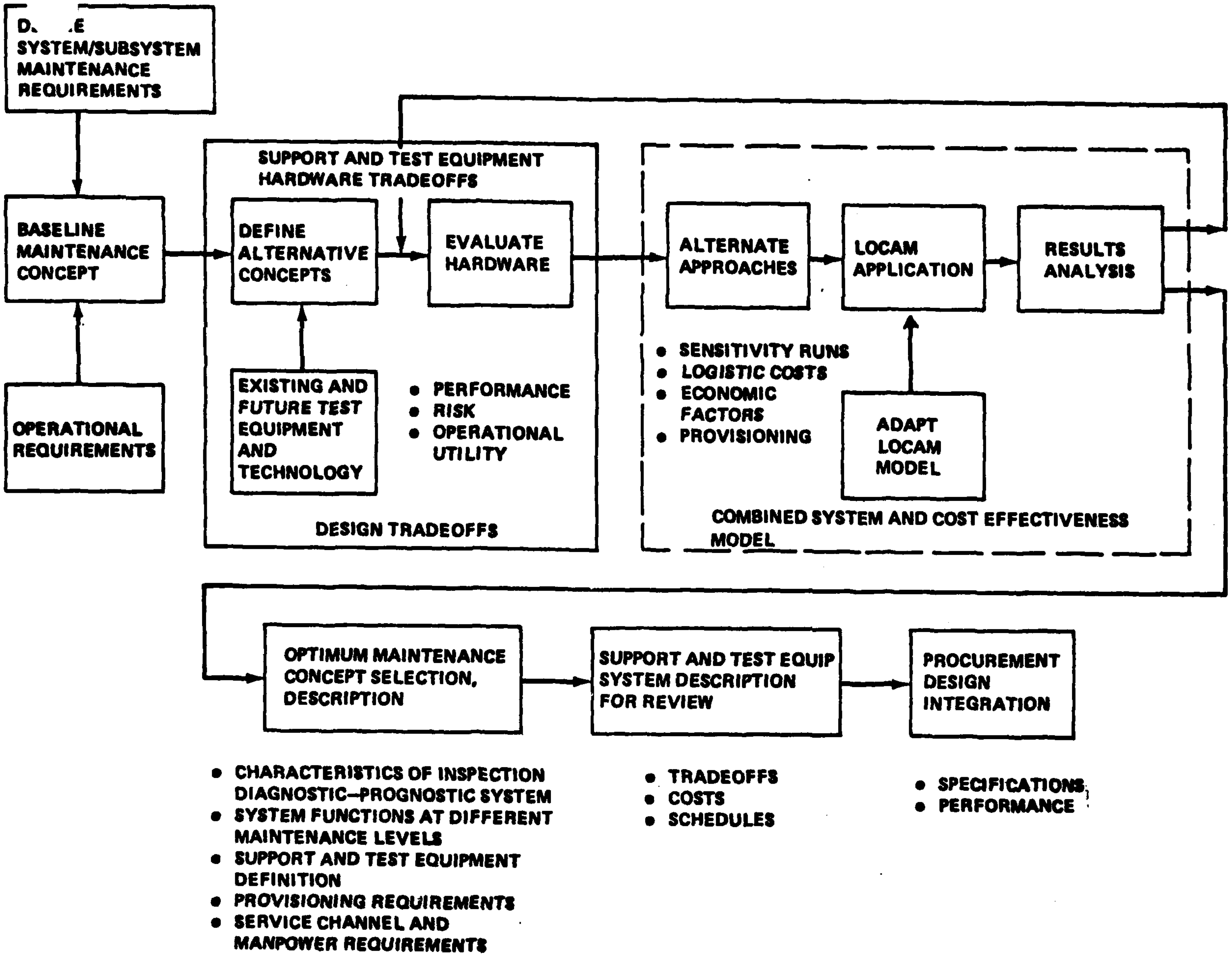


Figure 5. Support and Test Equipment Interface With Overall Logistics Model Tradeoffs.

c) To evaluate administrative and clerical costs of the support and replenishment system.

d) To study manpower costs. Can manpower costs be reduced (by introducing new equipment or techniques) sufficiently that overall costs are also reduced? At what point in time is the investment "paid back" by reduced manpower costs.

The preceding list is not an all inclusive one; however, it serves to indicate the versatility of the model.

2.4 Logistic Cost Factors

LOGAM support analysis considers the costs associated with four phases of the life of an equipment or system: development, production, operation, and end-of-program salvage. Salvage is an event rather than a life cycle time period.

LOGAM analysis generates a total LCC for each alternative support policy considered. The summary cost matrix is shown in Table 2. The mnemonics in Table 2 are the names given to the cost factors in the program; they are meaningful to indicate the cost element and program phase combinations for which costs are computed. Table 2 indicates the wide range of cost areas which may be considered in a LOGAM run.

2.5 Test Equipment and Manpower Modeling

In LOGAM, five types of test equipment and associated manpower can be modeled. Two types are used to represent Field or Depot service channels. By suitable selection of program controls (Appendix B) the maintenance manpower at these service channels can either be shared or dedicated. Type I test equipment is generally used to represent Field or Depot ATE. Type II generally represents Depot manual test equipment. Type I can always be Field located. By a suitable setting of a program control, either Type I or II will be Depot located (they cannot be concurrently modeled at Depot). The other three types of test equipment were originally included to represent:

a) Contact support sets and teams.
b) Calibration equipment sets and teams.
c) Built in Test Equipment (BITE)

2.6 Modeling Assumptions

As previously noted, the Maintenance Analysis Section LOGAM is logistic support oriented and takes a detailed look at the maintenance aspects of cost after the equipment becomes operational. Acquisition costs including development, production costs per item of equipment and nonrecurring production costs are accounted as model inputs.

LOGAM assumes a homogenous deployment of the support and supply echelons. This implies that the maintenance hierarchy is such that the workload arriving at a maintenance level (Organization, Direct Support, General Support, or Depot) is equally distributed between maintenance

TABLE 2. LOGAM SUPPORT COST MATRIX

Element of Cost	Acquisition		Time Phase		
	Development	Production	Replenishment Support for N Years	Salvage Value at End of Program	Sub-Total by Element of Cost
Prime Equipment	CED	CEP	*	CEV	CET
Test Equipment	CTSD/ CTSOFT	CTSP	CTSR	CTSV	CTST
Facilities			CFR		CFT
Manpower	--	CMPPY	CMPR/ CMPRR	--	CMPT
Material	--	CIVP	CIVR	CIVV/CSVR	CIVT
Reorder Cost	--	--	CROR	--	CROT
Storage Cost			CWHR		CWHT
Supply Administration	--	CSAP	CSAR	--	CSAT
Shipping and Handling			CSHR	--	CSHT
Cost Totals	CD	CP	CR	CS	GCT
Present Value Totals	PVCD	PVCP	PVCR	PVCS	PVGCT

*Per other entries.

facilities deployed at a particular echelon. Supply is equally distributed to the number of supply points located at each echelon.

LOGAM owes its ability to run rapidly on a computer to the fact that it is a deterministic model as opposed to simulation models which represent a system's behavior as a function of time. These latter classes of models are often complex. They generally employ Monte Carlo techniques and consume considerable computation time.

The LOGAM computer analyses generally assume a constant deployment such that the operational costs are the same for each year during the O&M phase. The inclusion of program "phase-in" is important, it can be accommodated by successive computer runs tc represent the yearly buildup of a deployment and increased equipment utilization.

2.7 Modeling Limitations

There are many advantages to LOGAM applications. These, however, are not panaceas that handle all problems of the system developer or user, nor are they without limitations. LOGAM studies must be examined to recognize the limitations built into them, or the premises generated based on "given" information.

The more prominent limitations inherent in analytical studies using LOGAM are as follows:

a) Accuracy of input data (particularly failure rate and equipment utilization data).
b) Improper data usage.
c) Inadequate problem definition.
d) Interjection of bias.
e) Poor assumptions.
f) Failure to reappraise.
g) Future uncertainties.
h) Interaction of variables when changes are made (for example, G factors,

The preceding limitations can be minimized by sensitivity testing which increases visibility and permits factors to be refined and adjusted to show their significance on logistics support costs.

SECTION 3

MAINTENANCE POLICY SELECTION

The logistic and maintenance support system possibilities which may be considered comprise twenty basic maintenance policies with four possible levels of inventory support for each. The 20 basic maintenance policies are summarized in Figure 6. LOGAM additionally allows the analyst to split maintenance policy and stock location - this leads to a number of combinations which are essentially unlimited.

3.1 Policy "G" Factors

The LOGAM deployment matrix shows four possible levels of maintenance support: at Equipment, Direct Support, General Support, and Depot. The model additionally assumes that faults are identified in accordance with the LRU removal rate (E) at the equipment level. LOGAM also provides three levels of maintenance support capability: unit checkout (COU), fault isolation of the unit to a faulty module (FIM), and module test and repair (FIP). It provides three levels of discard: unit, module, and part.

The maintenance levels at which work is performed and test equipment, test, and repair manpower locations are specified by "G" factors. These are the same "G" terms illustrated on Figure 6. The same factors are used to define the flow of maintenance work in system deployment. These input factors GA through GT must total unity so that all work is accounted for. These factors are:

GA = Specifies a policy of discard at failure. There are no maintenance support activities. All failure, false no-go indications, and attrition rate inputs result in LRU discard. Only LRUs are stocked in the supply system. There is no demand for modules or parts.

GB = Similar to GA but here is a provision to detect false no-go's at Direct Support and only failed and attrited LRUs are discarded. There is no demand for module or part stock. There is a demand for checkout service at Direct Support and the algebra uses Type I test equipment input data for this.

GC = Specifies LRU repair at equipment level by removing and replacing a defective module. The defective module is discarded.

GD = Specifies LRU repair at Direct Support by removing and replacing a defective module. The defective module is discarded.

GE = Specifies LRU repair at General Support by removing and replacing a defective module. The defective module is discarded.

FOR THE MAINTENANCE POLICY DESIGNATED BY

TEST EQUIPMENT WILL BE LOCATED AT	*	TEST EQUIPMENT CAN ISOLATE FAULTS TO THIS LEVEL	GA	GB	GC	GD	GE	GF	GG	GH	GI	GJ	GK	GL	GM	GN	GO	GP	GQ	GR	GS	GT
EQUIPMENT	TRC	LRU	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EQUIPMENT	TE TER	MODULE			X						X	X	X									
DIRECT SUPPORT	TC	LRU		X		X		X		X	X			X	X	X	X	X	X			
DIRECT SUPPORT	TF TFR	MODULE				X					X			X	X	X						
DIRECT SUPPORT	TMO TMOR	PART									X			X								
GENERAL SUPPORT	TC	LRU					X	X				X			X		X	X		X	X	
GENERAL SUPPORT	TI TIR	MODULE					X	X				X			X		X	X		X	X	
GENERAL SUPPORT	TMI TMIR	PART										X			X		X			X		
DEPOT	TC	LRU							X	X			X			X		X	X		X	X
DEPOT	TD TDR	MODULE							X	X			X			X		X	X		X	X
DEPOT	TMD TMDR	PART											X			X		X	X		X	X
REPAIR WILL BE ACCOMPLISHED BY DISCARDING AND REPLACING THE FAILED.			LRU	LRU	MODULE	MODULE	MODULE	MODULE	MODULE	MODULE	PART	PART	PART	PART	PART	PART	PART	PART	PART	PART	PART	PART

* LOGAM MNEMONIC

Figure 6. Maintenance Policy Matrix

GF = Specifies LRU repair at General Support with checkout performed at Direct Support to remove false no-go LRUs before sending the work to General Support. LRU repair is by removal and replacement of a defective module and the defective module is discarded.

GG = Specifies LRU repair at Depot. Defective modules are discarded.

GH = Specifies LRU repair at Depot preceded by a checkout at Direct Support to screen false no-go's.

GI = Specifies LRU repair at equipment level and module repair at Direct Support.

GJ = Specifies LRU repair at equipment level and module repair at General Support.

GK = Specifies LRU repair at equipment level and module repair at the Depot.

GL = Specifies LRU and module repair at Direct Support.

GM = Specifies LRU repair at Direct Support and module repair at General Support.

GN = Specifies LRU repair at Direct Support and module repair at Depot.

GO = Specifies checkout to catch false no-go's at Direct Support followed by LRU and module repair at General Support.

GP = Specifies checkout to catch false no-go's at Direct Support followed by LRU repair at General Support and module repair at Depot.

GQ = Specifies LRU checkout to catch false no-go's at Direct Support followed by LRU and module repair at Depot.

GR = Specifies LRU and module repair at General Support.

GS = Specifies LRU repair at General Support and module repair at Depot.

GT = Specifies LRU and module repair at Depot.

The matrix of "G" factors as structured to form maintenance policies that are built into the LOGAM formulation is shown in Figure 6. This matrix identifies the support posture options available within the LOGAM model. These alternatives are designated GA through GT in the upper part of the matrix. Twenty alternatives are availale which can be combined so that a percentage of work is accomplished by one policy with the balance being accommodated by other policies selected from the

matrix. In the matrix, X indicates that the options listed around the perimeter of the chart apply for the block in which the X is located. A blank in a block indicates that there is no applicable action taking place.

For example, the X in the fourth column from the left in the fourth row from the top is to be interpreted in the following way:

(Start at the left-hand edge of the chart).

Test equipment will be located at DIRECT SUPPORT. For the maintenance policy designated "GD", test equipment at Direct Support can isolate faults to the level of the failed MODULE. Repair will be accomplished by discarding and replacing the failed MODULE.

By designating percentages of the work flow through values of the inputs GA through GT, work is assigned to Organization, Direct Support, General Support, and Depot and provides for overflow of UNIT/LRU repair to the next higher level as required. Scrap fractions, a portion of the work flow deemed not repairable, can be assigned to UNIT/LRU and modules at each maintenance level. Scrapped items are part of the cumulative material requirements for resupply stocks from higher levels.

3.2 Maintenance Policy Example

LOGAM Maintenance Policy GP with unit stock located at Direct Support is shown in Figure 7. Maintenance Policy GP places an LRU checkout capability at the Organization and Direct Support levels, a fault isolate to module at the general support level, and a module repair facility at the Depot level. All policies have ultimate recourse to a recorder cycle.

In policy GP, failed units are sent from Equipment to Direct Support. LRUs which test well at Direct Support - False Report of Failure - are returned to Equipment. Those which also fail at Direct Support are replaced with an LRU from stock and sent on to General Support.

At the General Support level, those LRUs successfully fault isolated to the module are repaired by module replacement and returned to LRU stock at Direct Support. The failed modules detected at General Support and any LRUs still not fault isolated are sent on to Depot.

Failed modules are repaired at Depot and any LRUs repaired at Depot are returned to stock. The black lines which flow upward in the center of the diagram represent the flow of failed LRUs from Equipment level through Direct Support and General Support to Depot. The dotted line from Direct Support back to Equipment represents the return of False Report of failure LRUs.

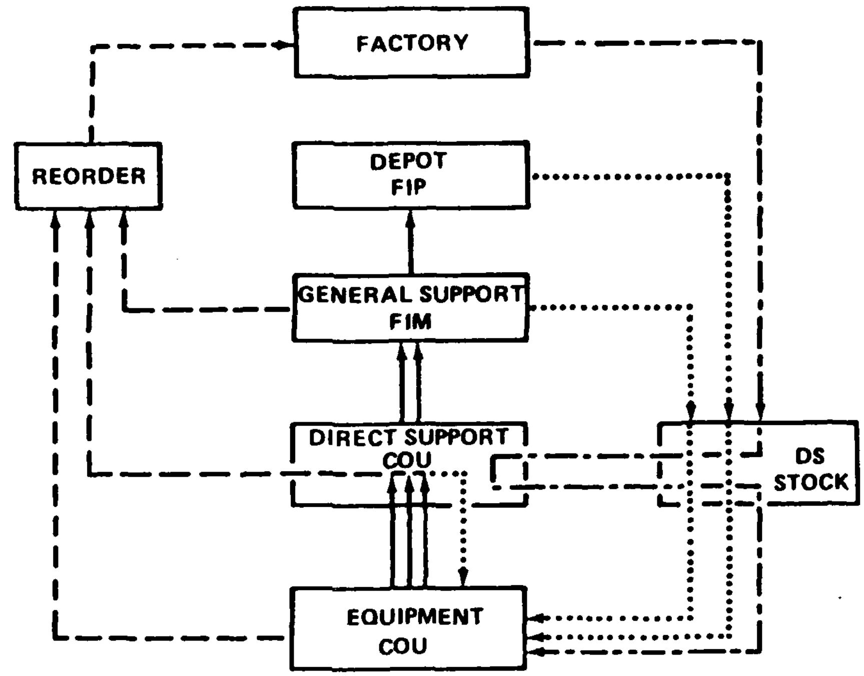


Figure 7. LOGAM Maintenance Policy GP.

The dotted lines from General Support and Depot to Direct Support stock represent the return of repaired LRUs to stock. The dashed lines represent an LRU reorder cycle which is satisfied by new LRUs from the factory which follow the combined dot-dash lines. The latter route from Direct Support stock to Direct Support and back represents a checkout of new LRUs before they are put into stock.

Figure 7 shows the pipelines associated with the flow of failed, repaired, and replacement LRUs. There are other (and spearate) pipelines for modules and parts which are not shown. Modules and parts are stocked "where used", in this case spare modules are stocked at General Support and Depot and spare parts are stocked at Depot.

The formulation also provides for a percentage (a program input) of LRUs and modules to be scrapped in maintenance activity at each level where they are subject to maintenance test and/or repair.

3.3 Repair Versus Discard and Optimum Repair Level Analysis (ORLA)

In defining the detailed maintenance concept and establishing criteria for equipment design, it is sometimes necessary to determine whether items should be repaired in the field (Direct Support or General Support), repaired at the Depot/Supplier facility, or discarded in the event of failure. As with other types of logistics cost analysis, the first step is to define the operational requirements in terms of equipment deployment, utilization, equipment characteristics, etc. Whether there are two equipments or 100 equipments deployed or whether the equipment is to be utilized 12 hours versus 4 hours per day are significant factors in the decision process.

The versatility of the LOGAM to perform repair level analysis or repair versus discard analysis can be seen by examination of the maintenance policy alternatives available in Figure 6. For the first two policies, there is no repair; the LRUs are discarded upon failure. Policy GB does provide a checkout at Direct Support to locate false no-go's. The next six policies perform LRU repair by discard at the module level and the rest repair faulty modules by fault isolating to the part level. Examples of repair level analysis are indicated by comparing policies GD, GE, and GG or GL, GR, and GT. In each instance, repair is performed at either Direct Support, General Support or Depot and an input deck structured to run these policies in consecutive order provides the means for performing repair level analysis. When the results for the different repair options are close, the analyst should review the data for validity and perform a sensitivity analysis to determine the impact on the decision as a result of input parameter variations. Applications where the model was used to perform repair level analysis have been documented.

3.4 Repair of LRUs and Modules

Cost to repair the LRUs and modules may be developed in LOGAM by computing manpower, test equipment, and material costs or can be modeled simply as so many dollars per repair. This might be representative of repair at a contractor facility where the Depot level is used as that facility. To model as dollars per repair the following inputs must be made:

CDPRMN = 8766	Number of hours per year on which costs are based.
TDPMI = 0 TDPMII = 1	Deletes productivity factor for test equipment manpower.
TDPRI = 1 TDPRII = 1	Eliminates productivity factor for repair manpower.
TDE = (Dollars per repair of LRU) TMDR= (Dollars per repair of module)	Creates terms where cost of repair manpower is really cost of repair.
FNSP = 0	Deletes parts cost. Presumably absorbed in TDR and TMDR.
FUD = 1 FMD = 1	Will repair all items and create no demand for reprocurement of LRUs and modules. Reprocurement is presumably absorbed in TDR and TMDR.
TD = 0 TMD=0	Deletes all cost for LRU and module test manpower at the depot.
EVDT = 1 EVDM = 1 EVDR = 1	Necessary to assure expected value charged per TDR and TMDR.

WDR = 168 WDM = 168 WD = 168	Necessary to maintain work week in order to not change constant 8766.
ARAD = 0	Deletes Depot manpower retraining cost.
TMDD = 0	Deletes manpower for installing MWO kits at Depot.
SUD = 0 SMD = 0	Creates no demand for reprocurement of scrapped LRUs and modules. All items arriving at Depot will presumably be repaired.

SECTION 4

LOGAM MAINTENANCE ANALYSIS USE PREPARATION

It is recommended that potential users be introduced to LOGAM by first exercising the model in their own computer facility. This entails compiling the program and exercising it with the furnished input sample problem. Appendix C of the manual sets up a realistic sample problem and describes the steps involved in applying the model. The descriptions define the problem, provide the input data base, and give portions of the program output printout. The user will need a computer with 200 kilobytes of memory and a FORTRAN IV, level G compiler. This section explains the procedural steps in gathering data for support cost analysis and using the model, explains how four different support channels are modeled, and provides important input data user notes.

4.1 The LOGAM Maintenance Analysis Program

The LOGAM program is specifically structured to perform logistic analysis in Army support situations when emphasis is placed on the support channels required for a diversity of operating equipments. In using the program, the analyst structures his input data as a sequence of installed equipments (LRUs) which require support. The program processes each equipment sequentially. Provision is made within the program to store cumulative demand for work at common test and repair facilities for several different LRUs. When setting up the input deck, the LRUs which share such common facilities are grouped. At the last LRU in the group, the cost for the support channels is computed based on the total workload in the accumulator. The accumulator is then reset and the next group of equipments may be processed.

Five types of support channels (test and support equipment) may be accommodated for a particular scenario being modeled. In the terminology of the program, these are designated as follows:

a) Type I can be located in Field or Depot and is sometimes* used to represent automatic test equipment.

b) Type II can be Depot located only and is sometimes* used to represent factory type manual test equipment.

c) Type III can be located in Field or Depot and is generally used to represent calibration equipment.

d) Type IV is generally used to represent contact support sets in the Field.

e) Type V will fault isolate and test major items in the field. Usually used to represent built-in-test equipment (BITE).

* Test equipment input factors are generic and development, acquisition and documentation or software cost factors can be subject to varied interpretations.

The maintenance policies and the integer control JTED control the location of the first two types of test equipment as follows:

a) If the value of JTED is input as 1, then Type I can be located in Depot.

b) If the value of JTED is input as 2, Type II can be located in Depot.

c) Type I test equipment can be field located regardless of the JTED value.

The essential features of the five test equipment categories are as follows:

a) Type I is modeled as test equipment performing LRU and module repair at Equipment, Direct, General, and Depot levels of support. An accumulator will accumulate total work demand over one or more equipments before posting out total costs. Inputs permit specification of LRU or module repair functions at Equipment, Direct, General, and Depot. Three accumulators are operative, namely, demand for test equipment, demand for test men and demand for repair men.

b) Type II is modeled as test equipment at Depot for performance of LRU and module repair. Inputs specify the repair capability fractions for LRUs and modules. Three accumulators are operative; namely, demand for test equipment, demand for test men, and demand for repair men. When TYPE I is specified at Depot, Type II at Depot is disabled, i.e., it cannot be concurrently modeled at Depot.

c) Type III calibration sets are modeled directly from inputs relating to total number of sets and men in the Field. There are no accumulators.

d) Type IV contact support sets are also modeled directly from inputs relating to total number of sets and men in the Field. There are no accumulators.

e) Type V test sets are used at the equipment level of support. They may be built-in to the major item. Estimates of the following are made for Type V equipment:

   (1) Test sets demanded (number and costs).
   (2) Unscheduled maintenance personnel (number and costs)
   (3) Training costs.

Inputs control the posting out of costs for each type of test equipment and their related costs. Specifically the costs which may be included are as follows:

a) Test Equipment development.

b) Development of technical data or programs for Type I of Type II test equipment

c) Test equipment acquisition.

d) Nonrecurring training.

e) Operation and maintenance costs for test equipment.

f) Costs for floor space.

g) Costs for test equipment men.

h) Costs for repair men.

The demand for Type I, Type II and Type V test equipments includes demand for their self-support, i.e., the computations account for enough test equipment to support the prime equipment and the test equipment itself. Test manpower is based on the total demand for support, i.e., prime equipment and the test equipment itself.

In addition to accounting for the cost for support channels, the program calculates the following:

a) Cost of prime equipment development, acquisition, salvage value.

b) Cost of spare units, modules, and parts for the prime equipment. The model determines the initial spares acquisition plus on-going consumption. Provision is made to charge for material storage. Salvage value may be taken on annual consumption and on end program terminal inventory. Separately, all or a fraction of the cost of the prime equipment, initial provision, and consumption may be sunk.

c) Companion to the cost of consumption of material is the cost of reordering.

d) Cost for shipping and handling.

e) Cost for supply administration.

f) Software costs.

Costs are developed over the sequence of the input equipments (LRUs) and carried forward in an accumulator until the last item. Totals are then printed by element of cost. Also, using an input interest fraction, the program phase totals and grand total are printed at present value which can reflect discount as well as inflation (definition of FINT in Appendix B).

4.2 Typical Procedural Steps

Application of the model for support cost analysis generally includes the following steps:

a) Establishing the data base.

   1) Deployment (scenario).
   2) LRU maintenance concepts.
   3) Basic data.
   4) Equipment (LRU) data.

b) Input deck preparation.

c) Performing baseline computer runs.

d) Performing sensitivity analysis.

e) Presentation of results.

Perhaps the most difficult part of applying the model is gathering the input data (establishing the data base). It is not uncommon for this procedure to take considerable time. This data gathering period encompasses the following tasks:

a) The delineation of prime system/equipment factors.

b) Data generated as the result of operations and support equipment analysis.

c) Determination of logistics factors.

d) Establishment of standard cost/time factors.

The synthesis of viable support systems is dependent upon the results of these activities. Alternate support systems which meet the workload demand are considered as prime tradeoff factors.

Many of the input data items are those the model requires to compute the various workload demands. The LOGAM model operates on demand for support, that is, maintenance workload generated by the prime equipment as postulated in the model. Workload or demand is generated as a function of operating hours expected maintenance incidents, number of operating components, and false failure indications. The support equipment also generates workload by virtue of its need for maintenance. Workload at a representative field test station is computed from:

a) The number of equipments operating in real time.
b) Equipment maintenance incident rate.
c) Test station testing rate for equipment, printed circuit boards, and modules/subassemblies.
d) Modification work order workload.
e) Self-test requirements.

Workload for each field repair station is similarly and separately computed as are test/repair workload at depot. From workload calculations, LOGAM determines the available time needed at each test station and where demand exceeds a set threshold, additional test stations are added as well as personnel and test station need for maintenance.

4.2.1 Data Gathering Worksheets. One way to organize the data gathering process is through the use of input data worksheets. Tables 3 and 4 present two worksheets which may be used. These tables list all the input data variables the LOGAM model uses. Definitions for the variables listed are given in the Glossary in Appendix B. Many times, data need not be input for all of the items listed. Particular problems may be structured to analyze a portion of the maintenance workload or the life cycle maintenance support costs. For example, a scenario may include several theaters of operation but initially the model may be used only to examine the USAREUR portion of the deployment. Other ideas of the simplifications possible may be determined by studying the sample problems presented in Appendix C and comparing their input data listing with Tables 3 and 4.

The beginning user of the LOGAM model is urged to contact the model using Army agencies for consultant help in initially adapting LOGAM to their application. Consultant aid is invaluable not only in setting up the input data, but in determining the expected outputs, determining why they do not occur, and analyzing what the results really mean.

Some problems run on LOGAM are structured during conceptual project phases. At that time, very few "hard" data are available. For that reason, LOGAM incorporates data values called default (BLOCK DATA) data. These data values are resident in the model and are indicated in Tables 3 and 4. The default value may also be used as the input data value if the user knows they are the same (i.e., the variable input data quantity need not be input in that case.) Many of the input data variables are used only to describe a particular LRU. These variables are preceded by an asterisk.

As can be noted, a blank space is left after the BLOCK DATA value is given. Therefore, these tables can be used as work sheets to record the input values prior to keypunching or other input processes. Table 4 is of particular interest because it shows the structure of the LOGAM input arrays such as H, OL, SL, etc. The blank spaces in this instance indicate the number of values necessary to fill the array.

As noted previously, the variables with asterisks in Table 3 indicate LRU descriptive quantities. Because a LOGAM application will typically involve many LRUs, these variables can effectively be removed from this list and placed on multi-LRU worksheets. The use of worksheets is highly recommended (pages 37-53).

Table 3. LOGAM Namelist Input Work Sheet-1 (Printed Values are Default Values-Punch Changes Only)

ARA	0.	CKMO	0.	*CUBEP	0.	FMI	1.	QTMO	0.	TDRMAN	0.	WER	168.
ARAD	0.	CKPD	0.	*CUBEU	0.	FMO	1.	QTO	0.	*TE	0.	WI	168.
AYZP	1.	CKPI	0.	CUCE	0.	FN	0.	QTPD	0.	TEMAN	0.	WIM	168.
CAD	0.	CKPO	0.	*CUP	0.	FNGF	0.	QTPI	0.	TENMAN	1.	WIR	168.
CALMAN	0.	CKUD	0.	CV	0.	*FNSP	1.	QTPO	0.	TEO	0.	*WM	0.
CALPUB	0.	CKUE	0.	DAOQL	1.	FSA	0.	RDD	0.	*TER	0.	WMR	48.
CALSET	0.	CKUI	0.	DD	1.	FTI	0.	REO	0.	TERMAN	0.	WMT	48.
CCAL	0.	CKUO	0.	DDS	1.	FTII	0.	*REPEAT	0.	*TF	0.	WO	168.
CCALP	0.	*CLRUPG	0.	DI	0.	FTM	0.	RF	.9	*TFR	0.	WOM	168.
CCALR	0.	*CMODPG	0.	DIS	0.	FTP	0.	RID	0.	TGMAN	0.	WOR	168.
CCSP	0.	*CMP	0.	DTE	0.	FTU	0.	ROI	0.	TGRMAN	0.	*WP	0.
CCSPP	0.	CONMAN	0.	*E	0.	FUD	1.	SMD	0.	*TI	0.	*WTKIT	0.
CCSPR	0.	CONTCT	0.	ED	0.	FUE	1.	SME	0.	TID	0.	*WU	0.
CDDI	0.	*CPE	0.	EDS	0.	FUI	1.	SMF	0.	*TIMW	0.	YAT	0.
CDEO	0.	CPI	0.	*EE	1.	FUO	1.	SMI	0.	TIO	0.	YD	0.
CDFD	0.	CPII	0.	EREI	1.	HPM	0.	SMO	0.	*TIR	0.	YMWO	0.
CDID	0.	CPP	0.	ETEI	1.	HPP	0.	*SPE	0.	*TMD	0.	YP	0.
CDIO	0.	CPUBII	0.	ETE	1.	HPU	0.	SPEV	1.	*TMDD	0.	YR	0.
CDMAN	0.	CPUBV	0.	ETI	1.	IBG	0.	SPEVR	1.	*TMDR	0.	YZ	0.
CDOE	0.	CPV	0.	ETII	1.	ILE	0.	SUD	0.	*TMI	0.	ZFL	.99999
CDOI	0.	CRI	0.	EVDM	1.	IOPER	0.	SUE	0.	*TMID	0.	*ZI	0.
CDPMAN	0.	CRIT	0.	EVDR	1.	OD	0.	SUI	0.	*TMIR	0.	*ZO	0.
CDPRMN	0.	CRM	0.	EVDT	0.	ODS	0.	SUO	0.	*TMO	0.	IO	2.
CDRMAN	0.	CRP	0.	EVEM	1.	*OTF	1.	SVE	0.	*TMOD	0.	IS	1
COIST	0.	CRU	0.	EVER	1.	*P	0.	SVR	0.	*TMOR	0.	JTED	1
CEMAN	0.	CRV	0.	EVET	0.	PMR	0.	SVT	0.	TOE	0.	NA	1
CEN	0.	CSDEF	0.	EVIM	1.	*PP	0.	SVV	0.	TOI	0.	NU	1
CEND	0.	CSDSU	0.	EVIR	1.	PPR	0.	TALMAN	0.	*TOMW	0.	DTI	0
CERMAN	0.	CSESU	0.	EVIT	0.	PUR	0.	TATE	0.	TONMAN	0.	DTO	0
CFTD	0.	CSGSU	0.	EVOM	1.	QMM	1.	*TC	0.	*TRC	0.	STAT	0
CGMAN	0.	CTCPUB	0.	EVOR	1.	QMP	1.	*TD	0.	TUMD	0.		
CGRMAN	0.	CTRA	0.	EVOT	0.	QMU	1.	TDI	0.	TUMI	0.		
CI	0.	CTRAD	0.	FE	.08	QTD	0.	TDMAN	0.	TUMO	0.		
CII	0.	CTRCAL	0.	FI	0.	QTE	0.	*TDMW	0.	WD	168.		
*CKIT	0.	CTRI	0.	FII	0.	QTI	0.	TDPMI	0.	WDM	168.		
CKMD	0.	CTRII	0.	FINT	0.	QTMD	0.	TDPMII	0.	WDR	168.		
CKME	0.	CTRSPT	0.	FMD	1.	QTME	0.	TDPRI	0.	WE	168.		
CKMI	0.	CTRV	0.	FME	0.	QTMI	0.	TDPRII	0.	WEM	168.		
		*CUBEM	0.					*TDR	0.				

* LRU Variables - use LRU worksheets

Table 4. LOGAM NAMELIST INPUT WORKSHEET-2 (PRINTED VALUES ARE DEFAULT VALUES, PUNCH CHANGES ONLY

```
GA      0.____     H(1)    0.
GB      0.____     H(2)    1.
GC      0.____     H(3)    1.
GD      0.____     H(4)    1.
GE      0.____     EACAL   0.
GF      0.____     EACSP   0.
GG      0.____     ETI     1.
GH      0.____     ETII    1.
GI      0.____     H       0.,1.,1.,1., ____,____,____,____
GJ      0.____
GK      0.____     OL      0.,0.,0.,0., ____,____,____,____
GL      0.____
GM      0.____     SL      0.,0.,0.,0., ____,____,____,____
GN      0.____
GO      0.____     OST     0.,0.,0.,0., ____,____,____,____
GP      0.____
GQ      0.____     TAT     0.,0.,0.,0., ____,____,____,____
GR      0.____
GS      0.____
GT      0.____
TAYZ    1.,1.,1.,1.,1.,1.,1.,1.,1.,1., ___,___,___,___,___,___,___,___,___,___
AU      .99999,.99999,.99999,.99999    ____,____,____,____
ZM      .99999,.99999,.99999,.99999    ____,____,____,____
ZP      .99999,.99999,.99999           ____,____,____
----------------------------------------------------------------------------
NB      0 ____
IFLAG   0 ____
INHIB   0 ____
IPAGE   0 ____
SENSY   266*0. ________________________________________
______________________________________________________
```

PROJECT -

LOGAM INPUT WORK SHEETS

1

ANNUAL FIELD TEST & REPAIR MANPOWER TURNOVER FRACTION.	ANNUAL DEPOT TEST & REPAIR MANPOWER TURNOVER FRACTION.	CONTROL NO. FOR COMPUTING INITIAL PROV QUANT. 1-MICOM RULE 0-LOGAM RATE -1-PROV INPUT	YEARLY COST IN $ TO RETAIN ITEM IN SUPPLY SYSTEM.	YEARLY COST IN $ PER MAN FOR A CALIBRATION MAN.	COST IN $ FOR TECH DATA FOR CALIBRATION TYPE III TEST EQUIP	NO. OF CALIBRATION TYPE III TEST SETS & TEAMS.	DEV COST IN $ FOR CALIBRATION TYPE III TEST EQUIP.	PROC COST IN $ FOR CALIBRATION TYPE III TEST SET.	YEARLY COST IN $ TO SUPPORT CALIBRATION TYPE III TEST SET.
ARA	ARAD	AYZP	CAD	CALMAN	CALPUB	CALSET	CCAL	CCALP	CCALR
DEV COST IN $ FOR CONTACT SUPPORT/ TYPE IV TEST SET.	PROC COST IN $ FOR CONTACT SUPPORT/ TYPE IV TEST SET.	YEARLY COST IN $ TO SUPPORT A CONTACT SUPPORT/ TYPE IV TEST SET.	SHIPPING FM DEPOT TO GS $ PER ITEM PER POUND PER TRIP.	SHIPPING FM INSTAL TO DS $ PER ITEM PER POUND PER TRIP.	SHIPPING FOR ONE WAY TRIP FM CONTRACTOR TO DEPOT. $ PER ITEM PER POUND PER TRIP.	SHIPPING FROM GS TO DEPOT. $ PER ITEM PER POUND PER TRIP.	SHIPPING FROM GS TO DS. $ PER ITEM PER POUND PER TRIP.	$ PER ITEM PER POUND TO DISTRIBUTE LRU & MODULE PROVISIONING.	SHIPPING FROM DS TO INSTALLATIO $ PER ITEM PER POUND PER TRIP.
CCSP	CCSPP	CCSPR	CDDI	CDEO	CDFD	CDID	CDIO	CDIST	CDOE
SHIPPING FROM DS TO GS. $ PER ITEM PER POUND PER TRIP.	YEARLY COST IN $ FOR TEST MAN AT DS.	YEARLY COST IN $ FOR TEST MAN AT DEPOT.	YEARLY COST IN $ FOR REPAIR MAN AT DEPOT.	YEARLY COST IN $ FOR REPAIR MAN AT DS.	YEARLY COST IN $ FOR TEST MAN AT EQUIP LEVEL.	COST IN $ TO ENTER LINE ITEM INTO THE SUPPLY SYSTEM.	YEARLY COST IN $ FOR REPAIR MAN AT EQUIP LEVEL.		COST IN $ PER SQ FT PER MONTH AT DEPOT FOR TEST EQUIP.
CDOI	CDMAN	CDPMAN	CDPRMN	CDRMAN	CEMAN	CEN	CERMAN		CFTD

$ PER YEAR FOR TEST EQUIP MAN AT GS.	$ PER YEAR FOR REPAIR MAN AT GS.	DEVELOP-MENT $ FOR TYPE I TEST EQUIP.	DEVELOP-MENT $ FOR TYPE II TEST EQUIP.	SAFETY STOCK COEF FOR MODULE STOCK AT DEPOT.	SAFETY STOCK COEF FOR MODULE STOCK AT *EQUIP* LEVEL.	SAFETY STOCK COEF FOR MODULE STOCK AT GS.	SAFETY STOCK COEF FOR MODULE STOCK AT *DS*.	SAFETY STOCK COEF FOR PART STOCK AT *DEPOT*.	SAFETY STOCK COEF FOR PART STOCK AT GS.
CGMAN	CGRMAN	CI	CII	CKMD	CKME	CKMI	CKMO	CKPD	CKPI
SAFETY STOCK COEF FOR PART STOCK AT DS.	SAFETY STOCK COEF FOR LRU STOCK AT DEPOT.	SAFETY STOCK COEF FOR EQUIP LEVEL SPARE LRU.	SAFETY STOCK COEF FOR LRU STOCK AT GS.	SAFETY STOCK COEF FOR LRU STOCK AT DS.	$ PER YEAR FOR CONTACT SUPPORT MAN.	NO OF CONTACT SUPPORT SETS & TEAMS.	ACQUISITION COST FOR TYPE I TEST SET.	ACQUISITION COST FOR TYPE II TEST SET.	$ FOR TECH DATA FOR TYPE II TEST EQUIP.
CKPO	CKUD	CKUE	CKUI	CKUO	CONMAN	CONTCT	CPI	CPII	CPUBII
COST IN $ FOR TECH DATA FOR TYPE V TEST EQUI.	PROCUREMENT COST IN $ FOR TYPE V TEST EQUIP.	$ PER YEAR FOR MATLS TO SUPPORT TYPE I TEST STATION.	$ PER YEAR FOR MATLS TO SUPPORT TYPE II TEST STATION.	$ PER MODULE REORDER ACTION.	$ PER PART REORDER ACTION.	$ PER LRU REORDER ACTION.	YEARLY COST IN $ FOR MATLS TO SUPPORT TYPE V TEST SET.	$ PER CU FT PER MONTH PER LINE ITEM FOR MATL STORAGE AT *DEPOT*.	$ PER CU FT PER MONTH PER LINE ITEM FOR MATL STORAGE AT *DS*.
CPUBV	CPV	CRI	CRII	CRM	CRP	CRU	CRV	CSDEP	CSDSU

$ PER CU FT PER MONTH PER LINE ITEM FOR MATL STORAGE AT EQUIP LEVEL.	$ PER CU FT PER MONTH PER LINE ITEM FOR MATL STORAGE AT GS.	$ FOR TECH DATA FOR CONTACT SUPPORT/ TYPE IV TEST EQUIP.	$ TO TRAIN ONE MAN FOR FIELD MAINT	$ TO TRAIN ONE MAN FOR DEPOT MAINT.	NONRECURR- ING $ TO SET UP TRAINING FOR CALIB- RATION/TYPE III TEST EQUIP TEAMS	NONRECURR- ING $ TO SET UP TRAINING FOR TYPE I TEST EQUIP	NONRECURR- ING $ TO SET UP TRAINING FOR TYPE II TEST EQUIP.	NONRECURRING $ TO SET UP TRAINING FOR CONTACT SUPPORT/ TYPE IV TEST EQUIP.	NONRECURR- ING $ TO SET UP TRAINING PROGRAMS FOR TYPE V TEST EQUIP.
CSESU	CSGSU	CTCPUB	CTRA	CTRAD	CTRCAL	CTRI	CTRII	CTRSPT	CTRV
$ PER YEAR TO PROVIDE ROUND-THE- CLOCK COVER- AGE FOR EQUIP LEVEL MAN POWER.	DEVELOPMENT COST IN $ FOR TYPE V TEST EQUIP.	FRACTION OF DEPOT WORK LOAD THAT IS GOOD WHEN DELIV- ERED TO FIELD STOCK- AGE POINT.	NO. OF DEPOT LEVEL MAINT LOCATIONS.	NO. OF DEPOT LEVEL SUPPLY POINTS.	NO. OF GS MAINT LOCATIONS.	NO. OF GS SUPPLY POINTS.	NO. OF DAYS DELAY EXPECTED FOR MAINT EVACUATION TIME AT EQUIP LEVEL	NO. OF DAYS DELAY EXPECTED FOR MAINT EVACUATION TIME AT GS.	NO. OF DAYS DELAY EXPECTED FOR MAINT EVACUATION TIME AT DS.
CUCE	CV	DAOQL	DD	DDS	DI	DIS	DTE	DTI	DTO
CONTROL FOR POSTING ONE TIME COST FOR CALIB/ TYPE III TEST EQUIP 0=NO POSTING 1=POSTING	CONTROL FOR POSTING ONE TIME COST FOR CTC SUP/ TYPE IV TEST EQUIP 0=NO POSTING 1=POSTING	TOTAL NO. OF EQUIP DEPLOYMENT LOCATIONS.	NO. OF EQUIP LEVEL SUPPLY POINTS.	EXCEPTED VALUE FLAG FOR TEST & REPAIR MEN ON MAJOR ITEMS AT EQUIP LEVEL.	CONTROL FOR POSTING WORK DEMANDS FOR MEN AND TYPE V TEST EQUIP 0=NO POSTING 1= POSTING	EXPECTED VALUE FLAG FOR TEST EQUIP ON MAJOR ITEMS AT EQUIP LEVEL.	CONTROL FOR POSTING WORK DEMANDS FOR TYPE I TEST EQUIP & REP AIR POSITION 0=NO POSTING 1=POSTING	CONTROL FOR POSTING WORK DEMANDS FOR TYPE II TEST EQUIP AT DEPOT. 0=NO POSTING 1=POSTING	EXPECTED VALUE FLAG FOR TEST EQUIP MAN POWER AT DEPOT.
EACAL	EACSP	ED	EDS	EREI	ETE	ETEI	ETI	ETII	EVDM

4

EXPECTED VALUE FLAG FOR TEST EQUIP MANPOWER AT EQUIP LEVEL.	EXPECTED VALUE FLAG FOR REPAIR MANPOWER AT DEPOT.	EXPECTED VALUE FLAG FOR TEST EQUIP MANPOWER AT DEPOT.	EXPECTED VALUE FLAG FOR REPAIR MANPOWER AT EQUIP LEVE.	EXPECTED VALUE FLAG FOR TEST EQUIP MANPOWER AT GS.	EXPECTED VALUE FLAG FOR REPAIR MANPOWER AT GS.	EXPECTED VALUE FLAG FOR TEST EQUIP AT EQUIP LEVEL.	EXPECTED VALUE FLAG FOR TEST EQUIP AT GS.	EXPECTED VALUE FLAG FOR TEST EQUIP MANPOWER. AT DS.	EXPECTED VALUE FLAG FOR REPAIR MANPOWER AT DS.
EVEM	EVDR	EVDT	EVER	EVIM	EVIR	EVET	EVIT	EVOM	EVOR
EXPECTED VALUE FLAG FOR TEST EQUIP AT DS.	FRACTION OF TYPE V TEST EQUIP MANPOWER ADDED FOR SELF SUPPORT.	FRACTION OF TYPE I TEST EQUIP MANPOWER ADDED FOR SELF SUPPORT.	FRACTION OF TYPE II TEST EQUIP MANPOWER ADDED FOR SELF SUPPORT.	YEARLY INTEREST RATE USED IN COMPUTATION OF PRESENT VALUE.	NO. OF IDENTICAL LRU'S IN A SYSTEM WHOSE FAILURE DOESN'T DETRACT FROM SYSTEM AVAILABILITY.	NO. TO SPECIFY THE RATIO OF FALSE NO-GO LRU DEMANDS TO TRUE FAILURES.	NONSTANDARD PART FRACTION RELATED TO THE COST FOR SUPPLY ADMINSTRATION.	FACTOR TO ACCOUNT FOR FIELD SUPPLY ADM COST. $/YR. LINE ITEM TYPE/FIELD SUPPLY LOC.	NO. OF FT² SPACE REQ AT DEPOT FOR TYPE I TEST EQUIP.
EVOT	FE	FI	FII	FINT	FN	FNGF	FNSP	FSA	FTI
NO. OF FT² SPACE REQ AT DEPOT FOR TYPE II TEST EQUIP.	TIME FACTOR IN WEEKS ASSOCIATED WITH MODULE REPROCUREMENT.	TIME FACTOR IN WEEKS ASSOCIATED WITH PARTS REPROCUREMENT.	TIME FACTOR IN WEEKS ASSOCIATED WITH LRU REPROCUREMENT.	DISCRETIONARY PROCUREMENT HOLDING TIME IN DAYS FOR MODULES.	DISCRETIONARY PROCUREMENT HOLDING TIME IN DAYS FOR PARTS.	DISCRETIONARY PROCUREMENT HOLDING TIME IN DAYS FOR LRU'S.	DESIGNATE TYPE & LOC TEST EQUIP. 1=TYPE I AT DS, GS, DEP. 2=SAME AS 1 PLUS TYPE II AT DEPOT.	NO. OF DS MAINTENANCE LOCATIONS.	NO. OF DS SUPPLY OR STOCK TRANSFER POINTS.
FTII	FTM	FTP	FTU	HPM	HPP	HPU	JTED	OD	ODS

ARRAY DIMEN FOUR REP OPER LEVEL OF SUP DAYS FOR CONSUM-ABLES AT EQUIP, DS, GS, DEPOT.	ARRAY DIMEN FOUR REP ORDER & SHIP TIME IN DAYS FOR EQUIP, GS, DS, DEPOT SUPPLY POINT.	FRACTION OF REAL TIME THAT INSTALLED EQUIP OPERATES.	PRODUCTION RATE FOR MODULES.	PRODUCTION RATE FOR PARTS.	PRODUCTION RATE FOR LRU'S.	MINIMUM REORDER QUANTITY FOR MODULES.	MINIMUM REORDER QUANTITY FOR PARTS.	MINIMUM REORDER QUANTITY FOR LRU'S.	TOTAL DEPOT LEVEL LRU STOCK QUANT FOR ALL DDS LOCATIONS.
OL	OST	OTF	PMR	PPR	PUR	QMM	QMT	QMU	QTD
TOTAL ORGANIZATION LEVEL LRU STOCK QUANT FOR ALL EDS LOCATIONS.	TOTAL GS LEVEL STOCK QUANT FOR ALL DIS LOCATIONS.	TOTAL DS LEVEL LRU STOCK QUANT FOR ALL ODS LOCATIONS.	TOTAL DEPOT LEVEL MODULE STOCK QUANT FOR ALL DDS LOCATIONS.	TOTAL ORGANIZATION LEVEL MODULE STOCK QUANT FOR EACH EDS LOCATION.	GS LEVEL MODULE STOCK QUANT FOR EACH DIS LOCATION.	DS LEVEL MODULE STOCK QUANT FOR EACH ODS LOCATION.	DEPOT LEVEL PART STOCK QUANT FOR EACH DDS LOCATION.	GS LEVEL PART STOCK QUANT FOR EACH DIS LOCATION.	DS LEVEL PART STOCK QUANT FOR EACH ODS LOCATION.
QTE	QTI	QTO	QTMD	QTME	QTMI	QTMO	QTPD	QTPI	QTPO
DELAY TIME IN DAYS BETWEEN REQ FOR LRU AT DEPOT & HANDLING OF REQ AT SUPPLY POINT.	DAYS BETWEEN SUPPLY ALLOW OF COND MODS & PARTS & NO OF DAYS OF SUPPLY FOR LRU'S & REP MOD'S AT GS.	DAYS BETWEEN SUPPLY ALLOW OF COND MODS & PARTS & NO OF DAYS OF SUPPLY FOR LRU'S & REP MOD'S AT EQUIP LEVEL	DAYS BETWEEN SUPPLY ALLOW OF COND MODS & PARTS & NO OF DAYS OF SUPPLY FOR LRU'S & REP MOD'S AT DS.	ARRAY DIMEN FOUR REP SAFETY LEV OF SUPPLY IN DAYS FOR EQUIP, DS, GS, DEPOT SUPPLY POINTS.	SCHEDULE MAINT FRACTION.	FRACT FOR CONTROLLING SUNK PORTION OF PRIME EQUIP COST. 1=FULL COST 0=NO COST	FRACT TO CONTROL SINKING OF COST OF INITIAL PROVISION. 1=FULL COST 0=NO COST	FRACT TO SINK COST OF CONSUMED MATERIAL. 1=FULL COST 0=NO COST	SHIPPING TURN-AROUND TIME IN DAYS FOR LRU,MOD FM REAR-MOST MAINT UNIT TO DEPOT & RETURN.
RDD	RID	REO	ROI	SL	SMF	SPE	SPEV	SPEVR	STAT

SALVAGE FRACTION FOR COST OF LRU'S AT THE END OF THE LIFE OF THE PROGRAM	SALVAGE FRACTION FOR COST OF CONSUMED MATERIAL.	SALVAGE FRACTION FOR COST OF TEST EQUIP.	SALVAGE FRACTION FOR COST OF RESIDUAL INVENTORY.	NO. OF TEST MAN PER CALIBRATION CREW.	ARRAY DIMEN FOUR REP MAINT TURN-AROUND TIME IN DAYS AT EQUIP, DS, GS, DEPOT LRU REPAIRS	AVG LENGTH OF TURN-AROUND TIME IN DAYS TO OBTAIN LRU OR MOD FROM EQUIP,DS,GS, DEPOT STOCK	PIPELENGTH IN DAYS FROM DEPOT TO GS	MANPOWER PRODUCTIVITY FACTOR OR NO. OF MEN PER TEST CREW AT DS.	MANPOWER PRODUCTIVITY FACTOR PER TYPE I TEST EQUIP CREW AT DEPOT.
SVE	SVR	SVT	SVV	TALMAN	TAT	TATE	TDI	TDMAN	TDPMI
MANPOWER PRODUCTIVITY FACTOR PER TYPE II TEST EQUIP CREW AT DEPOT.	MANPOWER PRODUCTIVITY FACTOR PER REPAIR CREW AT DEPOT FOR TYPE I TEST EQUIP.	MANPOWER PRODUCT-IVITY FACTOR PER REPAIR CREW AT DEPOT FOR TYPE II TEST EQUIP.	MANPOWER PRODUCT-IVITY FACTOR PER TEST CREW AT DS.	PIPE LENGTH IN HRS BETWEEN EQUIP LEVEL AND DS OR EXPEDITED TIME FOR OBTAINING SPARE.	MANPOWER PRODUCT-IVITY FACTOR PER TEST CREW AT EQUIP LEVEL.	MANPOWER PRODUCT-IVITY FACTOR PER REPAIR CREW AT EQUIP LEVEL.	MANPOWER PRODUCT-IVITY FACTOR APPLIED TO MTTR AT THE EQUIP LEVEL	MANPOWER PRODUCT-IVITY FACTOR PER TEST CREW AT GS.	MANPOWER PRODUCT-IVITY FACTOR PER REPAIR CREW AT GS.
TDPMII	TDPRI	TDPRII	TDRMAN	TEO	TEMAN	TERMAN	TENMAN	TGMAN	TGRMAN
PIPELENGTH IN DAYS FROM GS TO DEPOT	PIPELENGTH IN DAYS FM GS TO DS	PIPE LENGTH IN HRS BETWEEN DS & EQUIP LEVEL OR EXPEDITED TIME FOR OBTAINING SPARE.	PIPELENGTH IN DAYS FROM DS TO GS	NO. OF MEN PER CONTACT SUPPORT CREW (TYPE IV TEST EQUIP).	SUPPLY ALLOW IN HRS FOR MOD'S AT DEP TO COVER REM TIME FM LRU UNTIL MOD IS REPAIR & RTN MAINT POL GN GP, GQ, GS, GT.	SUPPLY ALLOW IN HRS FOR MOD'S AT GS TO COVER REM TIME FM LRU UNTIL MOD IS REPAIR & RTN MAINT POL GM GQ, GR	SUPPLY ALLOW IN HRS FOR MOD'S AT DS TO COVER REM TIME FM LRU UNTIL MOD IS REPAIR & RTN MAINT POL GL	SCHEDULED WORK WEEK IN HRS FOR TEST EQUIP AT DEPOT.	SCHEDULED WORK WEEK IN HRS FOR TEST CREWS AT DEPOT.
TID	TIO	TOE	TOI	TONMAN	TUMD	TUMI	TUMO	WD	WDM

7

SCHEDULED WORK WEEK IN HRS FOR REPAIR CREW AT DEPOT.	SCHEDULED WORK WEEK IN HRS FOR TEST EQUIP AT EQUIP LEVEL.	SCHEDULED WORK WEEK IN HRS FOR REPAIR CREW AT EQUIP LEVEL.	SCHEDULED WORK WEEK IN HRS FOR TEST EQUIP CREWS AT EQUIP LEVEL.	SCHEDULED WORK WEEK IN HRS FOR TEST EQUIP AT GS.	SCHEDULED WORK WEEK IN HRS FOR TEST CREWS AT GS.	SCHEDULED WORK WEEK IN HRS FOR REPAIR CREWS AT GS.	SCHEDULED WORK WEEK IN HRS FOR REPAIR MEN AT EQUIP LEVEL PERFORMING TRC WORK.	SCHEDULED WORK WEEK IN HRS FOR TYPE V TEST EQUIP.	SCHEDULED WORK WEEK IN HRS FOR TEST EQUIP AT DS.
WDR	WE	WER	WEM	WI	WIM	WIR	WMR	WMT	WO
SCHEDULED WORK WEEK IN HRS FOR TEST CREWS AT DS.	SCHEDULED WORK WEEK IN HOURS FOR REPAIR CREW AT DS.	LENGTH OF PRODUCTION/ ACQUISITION PHASE IN YEARS.	LENGTH OF OPERATION & MAINT PHASE OF PROGRAM IN YEARS.	SHIFTS THE STARTING POINT OF PRESENT VALUE INTO THE O&S PHASE IN YEARS.	LENGTH OF DEVELOPMENT PHASE OF PROGRAM IN YEARS.				
WOM	WOR	YP	YR	YZ	YD				

PROJECT -

1

LRU NO	COEFFICIENT DESCRIPTION / LRU DESCRIPTION — LOGAM MNEMONIC	COST FOR LRU - $	AVG COST FOR SPARE OR REPLACEMENT MODULE - $	AVG COST FOR SPARE OR REPLACEMENT PART - $	STORAGE VOLUME IN FT^3 FOR AN LRU	STORAGE VOLUME IN FT^3 FOR A MODULE	STORAGE VOLUME IN FT^3 FOR A PART	FAILURE RATE PER OPERATING HOUR
		CUP	CMP	CPP	CUBEU	CUBEM	CUBEP	E

2

DESC & UNITS / LRU	NUMBER OF IDENTICAL LRU'S PER INSTALLATION	NUMBER OF MODULE TYPES PER LRU	NUMBER OF PART TYPES PER LRU	SHIPPING WEIGHT IN POUNDS FOR LRU	SHIPPING WEIGHT IN POUNDS FOR MODULE	SHIPPING WEIGHT IN POUNDS FOR PART	NUMBER OF UNIQUE LRU'S	NUMBER OF MWO'S PER YEAR PER LRU	COST IN DOLLARS FOR A MOD KIT
NO.	EE	P	PP	WU	WM	WP	REPEAT	YMWO	CKIT

3

DESC & UNITS / LRU	SHIPPING WEIGHT IN POUNDS OF MOD KIT	DEVELOPMENT COST IN DOLLARS FOR LRU	COST IN DOLLARS TO PROG & PROV TECH DATA FOR TYPE I TEST EQUIP FOR LRU REPAIR	COST IN $ TO PROG & PROV TECH DATA FOR TYPE I TEST EQUIP FOR MODULE REPAIR	NONRECURRING PRODUCTION COST IN $ FOR AN LRU	FRACTION OF TRC DEVOTED TO LRU REMOVE & REPLACE TIME EXC FAULT ISOL & RETEST	DOWN TIME IN HRS PER SVC DEMAND AT EQUIP LEVEL MTTR	TEST TIME IN HRS FOR LRU AT EQUIP LEVEL	REPAIR TIME IN HRS FOR LRU AT EQUIP LEVEL
NO.	WTKIT	CEND	CLRUPG	CMODPG	CPE	RF	TRC	TE	TER

DESC & UNITS / LRU	MEAN TIME IN HOURS TO TEST LRU AT DIRECT SUPPORT	REPAIR TIME IN HOURS FOR LRU AT DIRECT SUPPORT	TEST TIME IN HOURS FOR LRU AT GENERAL SUPPORT FAULT ISOLATE	REPAIR TIME IN HOURS FOR LRU AT GENERAL SUPPORT	TEST TIME IN HOURS FOR LRU CHECK-OUT AT DEPOT FAULT ISOLATE	REPAIR TIME IN HOURS FOR LRU AT DEPOT	TEST TIME IN HOURS FOR MODULE CHECK-OUT AT DEPOT	REPAIR TIME IN HOURS FOR MODULE AT DEPOT	MEAN TEST TIME IN HOURS FOR MODULE CHECK-OUT AT GENERAL SUPPORT
NO.	TF	TFR	TI	TIR	TD	TDR	TMD	TMDR	TMI

DESC & UNITS / LRU	REPAIR TIME IN HOURS FOR MODULE AT GENERAL SUPPORT	MEAN TEST TIME IN HOURS FOR MODULE CHECK-OUT AT DIRECT SUPPORT	REPAIR TIME IN HOURS FOR MODULE AT DIRECT SUPPORT	MEAN TEST TIME IN HOURS TO CHECK-OUT LRU AT DS, GS, OR DEPOT FOR FALSE NO-GO	MEAN TIME IN HOURS IN TEST POS PER MOD PER TEST SEQ AT DIRECT SUPPORT	MEAN TIME IN HOURS IN TEST POS PER MOD PER TEST SEQ AT GENERAL SUPPORT	MEAN TIME IN HOURS IN TEST POS PER MOD PER TEST SEQ AT DEPOT	TIME IN HOURS FOR MOD KIT INSTALL-ATION PER REPAIR CREW AT DIRECT SUPPORT	TIME IN HOURS FOR MOD KIT INSTALLATION PER REPAIR CREW AT-GENERAL SUPPORT
NO.	TMIR	TMO	TMOR	TC	TOMW	TIMW	TDMW	TMOD	TMID

6

DESC & UNITS / LRU	TIME IN HOURS FOR MOD KIT INSTALL-ATION PER REPAIR CREW AT DEPOT	FRACTION OF MWO'S INSTALLED AT GEN SUPPORT	FRACTION OF MWO'S INSTALLED AT DIRECT SUPPORT	DISCARD AT FAILURE, NO MAINT SUP ACTIVITIES, NO DEMAND FOR MODULES OR PARTS.	DETECT FALSE NO-GO'S AT DS. NO DEMAND FOR MODULE OR PARTS, DEMAND FOR C/O AT DS.	SPEC LRU REPAIR AT EQUIP LEVEL BY REMOVE & REPLACE DEF MODULE, DEF MODULE DISCARDED.	SPEC LRU REPAIR AT DS BY REMOVE & REPLACE DEF MODULE, DEF MODULE DISCARDED.	SPEC LRU REPAIR AT GS BY REMOVE & REPLACE DEF MODULE, DEF MODULE DISCARDED.	LRU REPAIR AT GS W/CHECK-OUT AT DS TO REMOVE FALSE NO-GO LRU'S PRIOR TO SENDING TO GS.
NO.	TMDD	ZI	ZO	GA	GB	GC	GD	GE	GF

DESC & UNITS / LRU	SPECIFIES LRU REPAIR AT DEPOT. DEFECTIVE MODULES DISCARDED.	SPECIFIES LRU REPAIR AT DEPOT PRE-CEDED BY CHECK-OUT AT DS TO SCREEN FALSE NO-GO'S	SPECIFIES LRU REPAIR AT EQUIP LEVEL & MODULE REPAIR AT DS.	SPECIFIES LRU REPAIR AT EQUIP LEVEL & MODULE REPAIR AT GS.	SPECIFIES LRU REPAIR AT EQUIP LEVEL & MODULE REPAIR AT DEPOT.	SPECIFIES LRU & MODULE REPAIR AT DS.	SPECIFIES LRU REPAIR AT DS & MODULE REPAIR AT GS.	SPECIFIES LRU REPAIR AT DS & MODULE REPAIR AT DEPOT.	SPECIFIES CHECK-OUT FOR FALSE NO-GO'S & LRU & MODULE REPAIR AT GS.
NO.	GG	GH	GI	GJ	GK	GL	GM	GN	GO

DESC & UNITS / LRU	SPECIFIES CHECK-OUT FOR FALSE NO-GO'S AT DS & LRU REPAIR AT GS & MODULE REPAIR AT DEPOT	SPECIFIES LRU CHECK-OUT FOR FALSE NO-GO'S AT DS & LRU & MODULE REPAIR AT DEPOT	SPECIFIES LRU & MODULE REPAIR AT GS.	SPECIFIES LRU REPAIR AT GS & MODULE REPAIR AT DEPOT.	SPECIFIES LRU & MODULE REPAIR AT DEPOT.	LRU SCRAP FRACTION AT EQUIP LEVEL.	LRU SCRAP FRACTION AT DS.	LRU SCRAP FRACTION AT GS.	LRU SCRAP FRACTION AT DEPOT.
NO.	GP	GQ	GR	GS	GT	SUE	SUO	SUI	SUD

DESC & UNITS / LRU	LRU REPAIR FRACTION AT EQUIP LEVEL.	LRU REPAIR FRACTION AT DS.	LRU REPAIR FRACTION AT GS.	LRU REPAIR FRACTION AT DEPOT.	MODULE SCRAP FRACTION AT EQUIP LEVEL.	MODULE SCRAP FRACTION AT DS.	MODULE SCRAP FRACTION AT GS.	MODULE SCRAP FRACTION AT DEPOT.	MODULE REPAIR FRACTION AT DS.
NO.	FUE	FUO	FUI	FUD	SME	SMO	SMI	SMD	FMO

DESC & UNITS / LRU	MODULE REPAIR FRACTION AT GS.	MODULE REPAIR FRACTION AT DEPOT.	ANNUAL ATTRITION FRACTION FOR LRU.						
NO.	FMI	FMD	YAT						

4.3 Input Deck Structure

The input to the model is through punched cards. A listing of the inputs for the example problem is contained in Appendix C. Each deck must have the computer control cards plus eight header cards preceding the data. The first four header cards may be either blank or punched, but they must all be there. The structure of the input deck is shown in Figure 8 and comprises the following elements.

a) Control Cards: These cards specify the job name, assign tapes and/or discs to be used, and the program execute card. They apply to the particular computer being used.

b) Header Cards:

   1) Text Cards - These four cards may contain information in Columns 1 through 72. The purpose of the text cards is to enable the analyst to print up to four lines of identifying information on each computer output page. (Must be 4 cards).

   2) "Analysis" Card - One card provides information in Columns 1 through 18. This may be identification of the analyst or some specific information on the analysis.

   3) Date Card - One card using the first 18 columns to allow for printing the date on the output pages.

   4) "Units" Card - One card stating the units of the output and totals printouts in words (Columns 1 to 36), and the numerical value of the multiplier to be used (Columns 42 to 51), (i.e., dollars, 100 dollars, 1000 dollars, etc.) for $1000, .001 in Columns 48-51.

   5) Total Card - Total is a non-recurring input card which indicates that a summation of each LRU for all theaters is called. Individual LRUs in the input data for each case (theater) must be identically sequenced for the LRU summation to be meaningful. The number of distinct LRUs for which a total is to be taken for each theater in a concept must also be punched on the TOTALS card, ending in Column 80.

c) Data Cards: LOGAM model input data uses the NAMELIST form. This allows data to be modified easily from one program pass to another. Only the elements of data that are different from those used in the preceding pass need to be entered. The deck is made up of a series of LRU "boxes", each series representing a particular case to be run. These cases define a support alternative and the related geographical scenarios. In each box, two leader cards provide identifying information (Columns 1 to 18 and 1 to 72 in that order). Next follows the

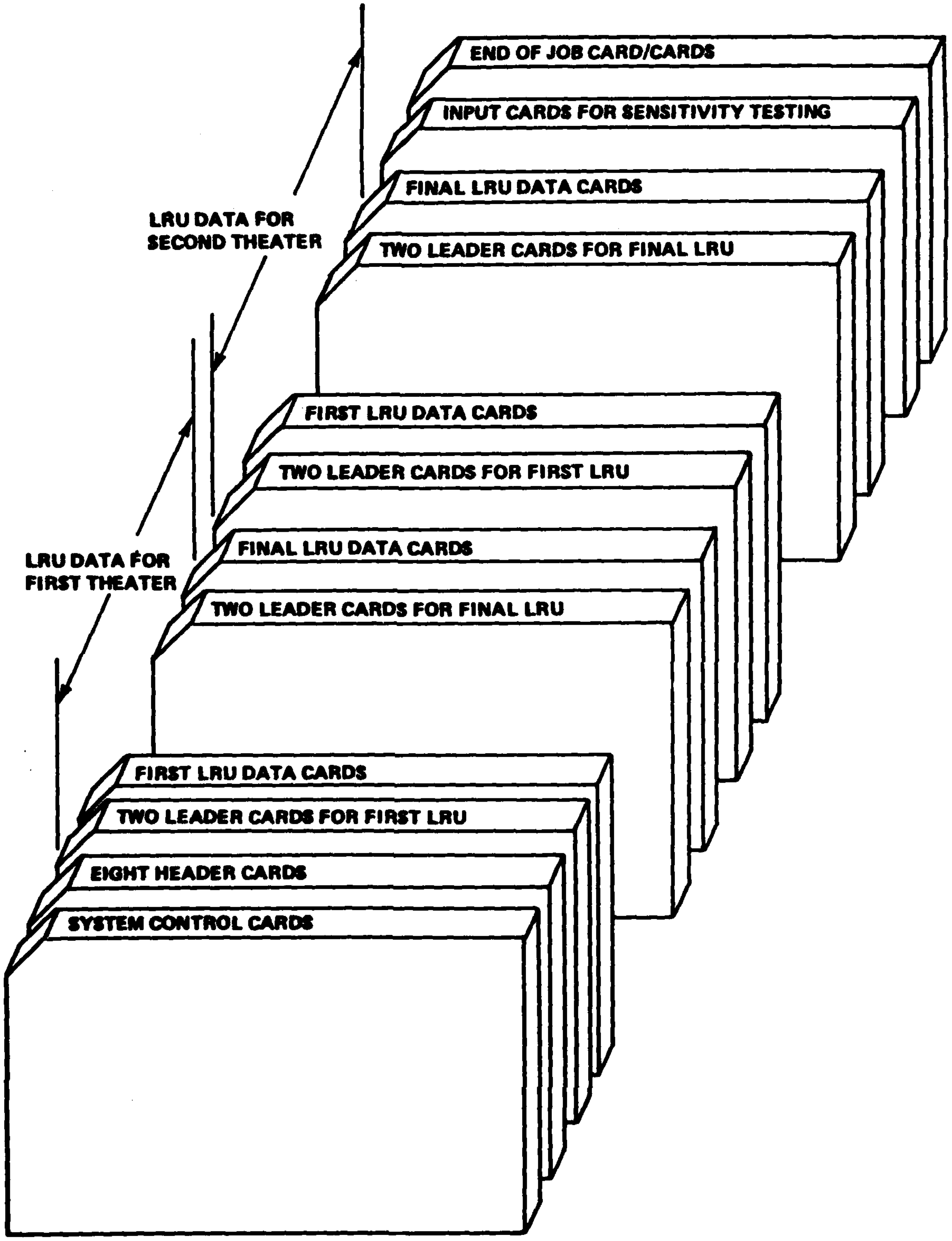


Figure 8. Input Deck Structure For Support Cost Analysis for Two Theater Scenario.

NAMELIST (Columns 2 to 80), with the final entry being an &END or $ depending on the computer used. The very last card in the deck contains a /* or other suitable end file card in Columns 1 and 2 to indicate the end of all data.

4.3.1 NAMELIST Data Organization. There are two types of NAMELIST data. One type, the $L type, is for all LRU data except Type V test data. The other type, the $LE type, is for Type V test data. NAMELIST data are identified by the first three columns on the first card: blank &L or $L (where L is the name of the NAMELIST). NAMELIST statements follow: their form is ABC=X, ABC is the name of an input variable, X is the assigned value. Column 1 is always blank; a comma separates each statement so that any number may be punched on a card, but once started, a statement must be completed on the same card. The end of the NAMELIST information is indicated by an &END or $.

In general, any input variable name which does not appear as a part of the NAMELIST retains the last value assigned to it. If a variable name appears more than once, the last input is the only one which remains in memory. Incorrect inputs (missspelled names or those not called for in the program) will cause the computer to reject the entire deck.

4.3.2 Input Cards for Sensitivity Testing. After the data set for the last box for baseline cases to be run, the input cards for sensitivity testing may be added. The sensitivity input data sets consist of at least three cards. The first two are leader cards used to identify certain characteristics of the sensitivity passes to be made. The third or subsequent cards are again in the NAMELIST format but follow the rules for setting up the sensitivity ARRAY discussed in detail in Section 4.

4.4 LOGAM Input Notes

The following paragraphs define and discuss inputs that are particularly important to the correct use of the model.

4.4.1 Program Controls. LOGAM uses several program controls which govern the computer operations for the particular problem under analysis:

The G factors (selects the maintenance concept).
AYZP.
Test Equipment and manpower tally controls.
Expected value flags.
NA.
JTED.
IO.
IS.
NU.
INHIB.
ILE

The first four controls in the preceding list are real numbers; the rest are integer controls.

a) G Factors: The maintenance concept is generally punched for each LRU in the data set because it is likely to vary between LRUs. Reference to Appendix C indicates that this approach was used in setting up the sample problem data set. When combination policies are used for the Class 2 and Class 3 LRU maintenance concepts, the sum of the maintenance policy fractions must total to unity to assure that all work is accounted for.

b) AYZP - AYZP governs the selection of supply/maintenance rules. A value of unity was used for the sample problem described in Appendix C. This selected the use of MICOM maintenance rules.

c) Test Equipment and Manpower Tally Controls: LOGAM incorporates four tally controls associated with the five possible types of test equipment as follows:

1) ETI   Type I test equipment.
2) ETII   Type II test equipment.
3) EACAL Type III test equipment.
4) EACSP Type IV test equipment.
5) ETE   Type V test equipment

These controls govern the posting of test equipment and manpower costs. Only the values 0 and 1 are permitted. The tally is taken when unity is input. Type I, Type II and Type V tallies are taken in accordance with the expected values flags which control the use of shared test equipment and manpower or integer round off. Type III and Type IV can only be deployed as dedicated test equipment sets and teams of manpower. Type V can be used as built in test equipment (BITE).

d) Expected Value Flags: There are fourteen of these flags in the LOGAM program. They are used to designate whether shared (expected value) or dedicated test equipment and manpower will be used. Only the values 0 and 1 are permitted. Zero selects dedicated test equipment and manpower and unity selects shared test equipment and manpower.

The program uses the following mnemonics for these flags:

EVET, EVOT, EVIT, EVDT — Flags for test equipment at Equipment, Direct Support, General Support, and Depot, respectively.

ETEI — Flag for BITE at equipment.
EREI — Flag for test and repairmen at equipment.

EVEM, EVOM, EVIM, EVDM — Flags for test manpower at Equipment, Direct Support, General Support, and Depot, respectively.

EVER, EVOR, EVIR, EVDR — Flags for repair manpower at Equipment, Direct Support, General Support, and Depot, respectively.

e) NA - NA controls the number of system availability modes to be tallied. Values from 1 to 10 can be assigned to NA permitting the determination of up to 10 availability modes. NA is input in combination with TAYZ (Section 4.4.2).

f) JTED - JTED controls the designation of Depot test equipment (Type I or Type II). For the sample problem (Appendix C), JTED=2 was input which designated Type II test equpment at Depot.

g) IO - IO controls the printout of NAMELIST, an abbreviated NAMELIST or a sequenced listing of all inputs. IO=0 inhibits the print-out of the inputs. IO=2 prints out all NAMELIST inputs. IO=1 prints the abbreviated NAMELIST. When IO=3 is input, the entire sequence of LRU input data for all LRUs will be printed. It is recommended that this control be used with the last LRU in an input sequence of LRUs. Thus, for example, if the user has a system consisting of eleven LRUs and he is examining them in five different deployments, then his total set of LRU inputs is eleven times five, or fifty-five. The control IO=3 should be input with the fifty-fifth set of LRU data. When so input, all fifty-five sets of input data will be printed in columnar fashion to facilitate examination of the sequence of inputs. This feature greatly facilitates the discovery of inadvertant input sequence error from LRU to LRU.

h) IS - IS controls the program reset functions (Appendix B). IS = 3 neutralizes all reset actions and must be in first LRU box of each theater to assure correct accumulator function. (For example if IS = 1 is input at the end of an LRU in order to get a subtotal then the next box IS = 3 must be input.) For the final LRU of the USAREUR data set in Appendix E, IS = 1 is input. This causes all inputs used for the very first LRU of the data set to be recalled for next LRU in the input sequence. Therefore, any inputs which pertain specifically to that LRU need to be keypunched for the next system data set. IS = 1, also resets availability, workload accumulators, and case total assumulators.

i) NU - NU controls the printout of totals pages. It is general input with the final LRU of theater or case. In the present problem (Appendix C), NU = -1, is input with the final LRU of the USAREUR deployment. This caused the printout of the case totals page for the USAREUR scenario. For the final LRU in the conus scenario, NU = -3 is input causing the printout of the case totals page for CONUS plus the printout of summary TOTALS pages for each LRU for both theaters. Finally, a GRAND TOTALS summation of the CASE TOTALS for USAREUR plus the CASE TOTALS for CONUS is printed out.

j) INHIB - INHIB controls the printout of the individual LRU OUTPUT pages. It is input as either one or zero. Unity inhibits the printout of LRU OUTPUT and zero allows the OUTPUT page to be printed.

k) ILE - Controls the reading of $LE input data. The program is structured to read an LRU block of $L data followed by $LE block, if required. ILE must be set on (=1) in the $L data to initiate reading $LE data. The flag may then be set off (=0) in the $LE data if further $LE reading is to be omitted.

4.4.2 Array Inputs. LOGAM uses the following array inputs:

H
TAYZ
ZU, ZM, ZP
SENSY
OL
OST
SL
TAT

a) H - H controls the allowable LRU stock locations. It is permissible to have LRU stock at any or all of four supply locations: at Equipment Level, at Direct Support, at General Support or at Depot. In the sample problem (Appendix C), H was input as:

H = 4*1.,

with the first LRU of the data set. This signifies that LRU stock is permitted at all locations because all elements of the array are input as unity. An input of zero would inhibit LRU supply at a particular location depending on which element of the array was input as the zero. The program will inspect the inputs QTE, QTO, QTI, and QTD to see if stock quantities have been input. If they have been input, the corresponding H element will be set to unity even if input as zero. This change to H, if made, is permanent until H is again input with some subsequent LRU.

b) TAYZ, Availability Tally Control, is the availability formulation in LOGAM which includes a set of ten availability accumulators. A new input, NA, described in Section 5.4.1, specifies how many of the ten accumulators are active. TAYZ is defined as an array of dimension ten. However, a value must be input for each of the availability accumulators. In the environment of the CDC 6600, ten values should be entered. Only the first NA of the ten is actually used; the remaining values have no effect.

For example, in the sample problem (Appendix C), the system consists of eleven LRUs. The arrangement of the LRUs in the input tray is such that the first four LRUs constitute the first subsystem, the next five constitute the second subsystem, and the last two constitute the third subsystem. In this instance, it is desirable to keep the availability tally for the total system and also for each subsystem. Four tallies are required; therefore, the input NA = 4 is used and the following are input for TAYZ:

LRU No	
1	TAYZ = 1., 1., 8*0.,
2	
3	
4	
5	TAYZ = 1.,0., 1., 7*0.,
6	
7	
8	
9	
10	TAYZ = 1., 2*0., 1, 6*0,
11	

All LRUs are tallied into the first accumulator, i.e., the first element of the TAYZ array is unity (1) for every LRU. The first value, 1 in boxes 1, 5, and 10 represents this direction. As has been stated previously the 1 is continued in boxes 2 through 4, 6 through 9 and 11. This tally will compute system availability. The first four LRUs are tallied into the second accumulator, i.e., the second element of TAYZ is unity for the first four LRUs and zero for all others. The second value in all the arrays represents this accumulator, therefore arrays in box 5 and 10 are zero. This zero is continued in boxes 6 through 9 and 11. LRUs 5 through 9 are tallied into the third accumulator, i.e., the third element of TAYZ is unity for these LRUs and zero for all others. The TAYZ array in box 5 represents this subsystem. The last two LRUs will be tallied into the fourth accumulator, i.e., the fourth element of TAYZ is unity for these and zero for all others. Values of TAYZ beyond the fourth element is immaterial because NA=4. The array would be arranged as follows if all values were input into each box.

LRU	ELEMENTS									
NO	1	2	3	4	5	6	7	8	9	10
1	1.,	1.,	0	0	0	0	0	0	0	0
2	1.,	1.,	0	0	0	0	0	0	0	0
3	1.,	1.,	0	0	0	0	0	0	0	0
4	1.,	1.,	0	0	0	0	0	0	0	0
5	1.,	0.,	1.,	0	0	0	0	0	0	0
6	1.,	0.,	1.,	0	0	0	0	0	0	0
7	1.,	0.,	1.,	0	0	0	0	0	0	0
8	1.,	0.,	1.,	0	0	0	0	0	0	0
9	1.,	0.,	1.,	0	0	0	0	0	0	0
10	1.,	0.,	0.,	1.,	0	0	0	0	0	0
11	1.,	0.,	0.,	1.,	0	0	0	0	0	0

On the case total output page, four availabilities will be printed across the page. The first is the system availability. The second is the availability of the first subsystem. The third is for the second subsystem. The fourth, and last, is for the third subsystem.

c) ZU, ZM and ZP - Stock Round-off Arrays - Array ZU., of dimension four, gives the round-off rule for LRU stock at Equipment, Direct Support, General Support, and Depot supply locations. Similarly, array ZM of dimension four gives the rule for module stock at Equipment,

Direct Support, General Support, and Depot locations. Array ZP gives the rule for part stock at the same three locations. The following inputs for these factors:

ZU = .5, .5, .99, .9999999

ZM = .9, .99, .9999999, .9999999

ZP = .9999999, .9999999, .9999999,

in LRU stock would mean:

1) At the E level, round one-half, i.e., if the demand for spare LRUs at E is less than one-half, stock zero.

2) At the Direct Support level, one-half is rounded. If the demand has a fractional part less than one-half, the next lower integer is used. If the demand is more than one-half, the next higher integer is stocked.

3) At the General Support level, if the demand fraction is greater or equal to 0.01, the next higher integer is stocked; otherwise, the next lower integer is stocked.

4) At the D level, if the demand fraction is greater or equal to 0.0000001, the next higher integer is stocked; otherwise the next lower integer is stocked.

Similar interpretations apply to the ZM and ZP rules.

These rules are used for both the LOGAM Supply Rules and the LOGAM Maintenance Rules. Fractional demands for stock are rounded up or down to an integer based on the addition of the Z fractions to the basic demand followed by truncation of the result of the addition to obtain a whole number.

d) SENSY is the array for sensitivity testing. SENSY is discussed in detail in Section 4.

e) TAT, OL, SL and OST are arrays for LOGAM Maintenance Rules. LOGAM incorporates three basic methods for calculating initial stockage (definition for AYZP in Appendix B). When using the LOGAM Maintenance Rule, four sets of pipeline inputs are in the form of arrays. These pipelines are known as "maintenance-turn-around times" for repairables and "operating level" , "safety-level", and "order-ship-times" for consumables. When used in this mode, LOCAM/COAMP pipeline times are used to specify down-time if stock outage occurs. Down-time, in this context, should reflect the expedited time to obtain a spare.

The TAT, OL, SL and OST are all input in days and are arrays of Dimension 4. The order of each array is for Direct Support, General Support, and Depot supplies.

4.4.3 New Inputs. LOGAM contains five additional NAMELIST inputs not in previous versions of the model:

STAT
DTI
DTO
IFLAG
ILE

STAT, DTI, and DTO are new inputs associated with the use of LOGAM Maintenance Rules. STAT is the shipping turn-around time in days for an LRU to go from a Field maintenance point to Depot and return. DTI is the expected delay time in days at General Support in evacuating a failed LRU to Depot. DTO is the expected delay time in days at Direct Support in evacuating a failed LRU to General Support or Depot.

IFLAG - IFLAG has been added to NAMELIST to suppress the printout of LRU summary totals. The summation of costs, etc. for each LRU for all theaters is suppressed if IFLAG=1 is input (description of program initialization card "TOTAL" in Section 4.3).

ILE - ILE is described in the previous Section 5.4.1 (Program Controls).

SECTION 5

OPERATION AND SUPPORT (O&S) COSTS

BASED ON TOE STRUCTURE

As an example, the MTOE for FA BN, Pershing forms the basis for describing operation and support costs derived from a typical TOE structure. The O&S cost equations described herein are added to the LOGAM maintenance cost model as a post-processor with suitable controls to activate this additional software device or not depending on the type of analysis desired. LOGAM, therefore, can be used to estimate life cycle logistics support costs without the addition of operational costs.

5.1 PAY AND ALLOWANCES FOR MILITARY PERSONNEL GRADES

The Pay and Allowances shown in Table 5 are based on data obtained from the Army Force Planning Cost Handbook(1) with suitable adjustments as indicated by the table footnote. The weighted average given for Grades E-9, E-8 and E-7 assumes three E-8s and six E-7s for each E-9 as typical weighting factors and three E-5s and two E-4s for each E-6 as the factors for weighting the pay and allowances of the E-4, E-5 and E-6 group. Where other averages are given in Table 5 they are numerical averages as suggested in the Army Force Planning Cost Handbook.

5.2 CREW PAY AND ALLOWANCES (3.011)(2)

Crew Pay and Allowances include base pay and allowances according to grade for military personnel whose primary function is to operate the weapon system being costed and may include a flight pay multiplier. Depending on organization, crew size may be the (number of operational equipment) x (number of crewmen per operational equipment) as in Figure 6.2 of DA PAM 11-4 or for missiles (for example, Pershing), the crew may be the personnel in the Field Artillery Battery (batteries). For the purpose of LOGAM, personnel will be combined in groups identified by grade and their pay and allowances and other cost factors will be averaged per DA PAM 11-4. To be consistent with the LOGAM Work Statement, TOE structure will be limited for four Army organizational levels or less.

(1) "Army Force Planning Cost Handbook", Directorate of Cost Analysis Office, Comptroller of the Army, Washington, D. C. 20310.

(2) Number in parenthesis refer to cost elements as defined in Chapters 2 and 6 of Department of Army Pamphlet No. 11-4, "Operating and Support Cost Guide for Army Material Systems", April 1976.

Table 5. Pay Allowances for Military Personnel (FY-79 Dollars)

Personnel Groupings		
Grade	Rank	Pay and Allowances[3]
0-10	General	$52452
0-9	LTG	51633
0-8	Maj. Gen.	48419
0-7	Brigadier Gen	42598
0-6	Col	
0-5	Lt.Col	29804 (average)
0-4	Major	
0-3	Captain	
0-2	1st Lt	18718 (average)
0-1	2nd Lt	
WO	Warrant Officer (W-1 - W-4)	18080 (average)
E-9	Sgt. Maj/Command SM	
E-8	MSG/1st SG	16759 (Weighted Average)
E-7	SFC/SP7	
E-6	Staff SG/SP6	
E-5	SGT/SP5	10469 (Weighted Average)
E-4	CPL/SP4	
E-3	PFC	
E-2	Private	7500 (average)
E-1	Recruit (Private)	

(3) Note: Includes basic allowance for quarters (BAQ) and allowance for subsistence (PAS) - from Army Force Planning Cost Handbook. plus two 7 percent increases since then to place manpower costs on a FY basis.

In order to determine operational costs excluding maintenance, the TOE of the organization under evaluation must be examined. As an example the organization based on the MTOE for FA BN Pershing is structured as shown in Figure 9 to illustrate the hierarchy of a typical Army organization and showing the correspondence to the TOE paragraph numbering system. Following preparation of an organizational structure such as shown in Figure 9, a TOE manpower breakdown table is prepared, an example of which is shown in Table 6 for the FA BN, Pershing. This table follows the organizational structure of Figure 9 and indicates the personnel grades at the various levels of the TOE organization and provides categorizations of all personnel in addition to crew which indicates whether specific personnel are overhead, dedicated, support, crew or those performing maintenance. The table also gives the annual allowance of the personnel corresponding to the values given in Table 5. Pay and allowances for maintenance personnel, however, are not provided since it is the intent to compute the maintenance manpower costs on an expected value basis using the logistic support cost analysis portion of the LOGAM program. In the implementation of the calculation for life cycle operational personnel costs, Table 6 becomes a data array which is stored in the computer and can be accessed to obtain various operational personnel pay and allowances:

Crew Personnel
Overhead Personnel
Dedicated/Support Personnel

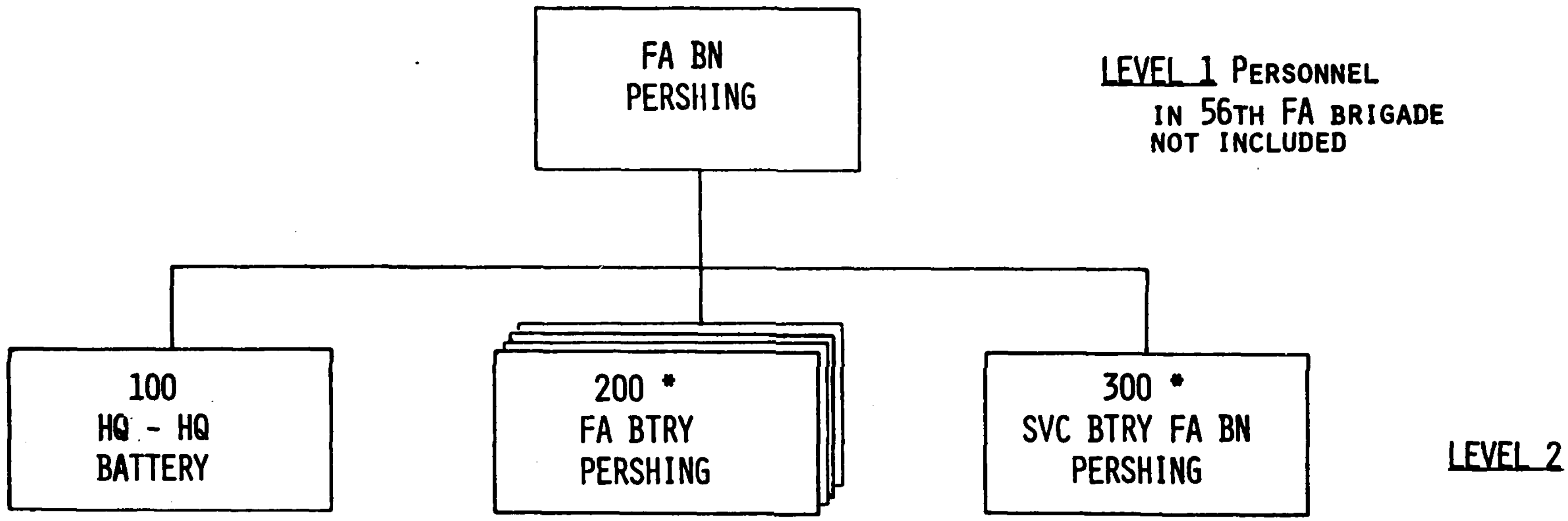
These personnel costs give the cost totals for each category and are summed to give total operational personnel costs.

5.3 MAINTENANCE PAY AND ALLOWANCES (3.012)

In the context of the LOGAM logistics analysis portion of the program, this element (3.012) includes base pay and allowances for military personnel at all levels of maintenance. No maintenance levels or maintenance personnel are excluded as indicated in DA PAM 11-4. For LOGAM maintenance pay and allowance will be handled on an expected value basis. However, where applicable, they will be modified according to DA PAM 11-4 element 3.051. (See paragraph 5.8)

As an example, to determine maintenance pay and allowance, a selected group of equipments were extracted from the Pershing MTOE and grouped as shown in Tables 7 and 8. Tables 9 and 10 were then prepared by an examination of the Pershing MTOE to determine the associated grade levels of the personnel performing field level (Organizational and Direct Support) maintenance on the selected equipments listed in Tables 7 and 8. The annual pay and allowances of the maintenance manpower as indicated in Tables 9 and 10 determines certain inputs to the logistics support cost analysis portion of the LOGAM program, namely the annual manpower input cost factors:

CEMAN
CERMAN
CDMAN
CDRMAN



* NOTE: MTOE PARAGRAPH NUMBERS

Figure 9. Field Artillery Battalion, Pershing Organization
Based on MTOE 06615GE101, CCNUM E10174.

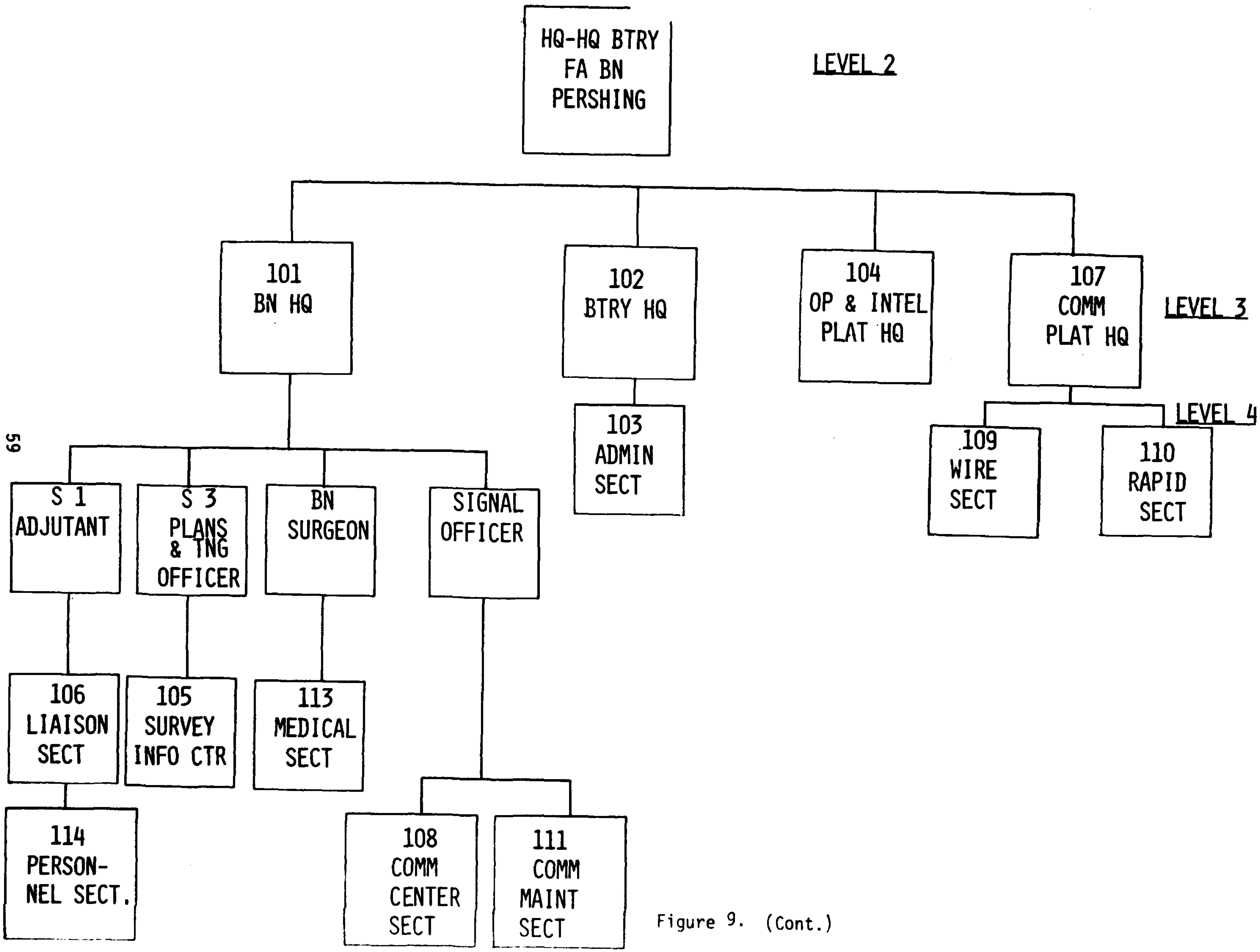


Figure 9. (Cont.)

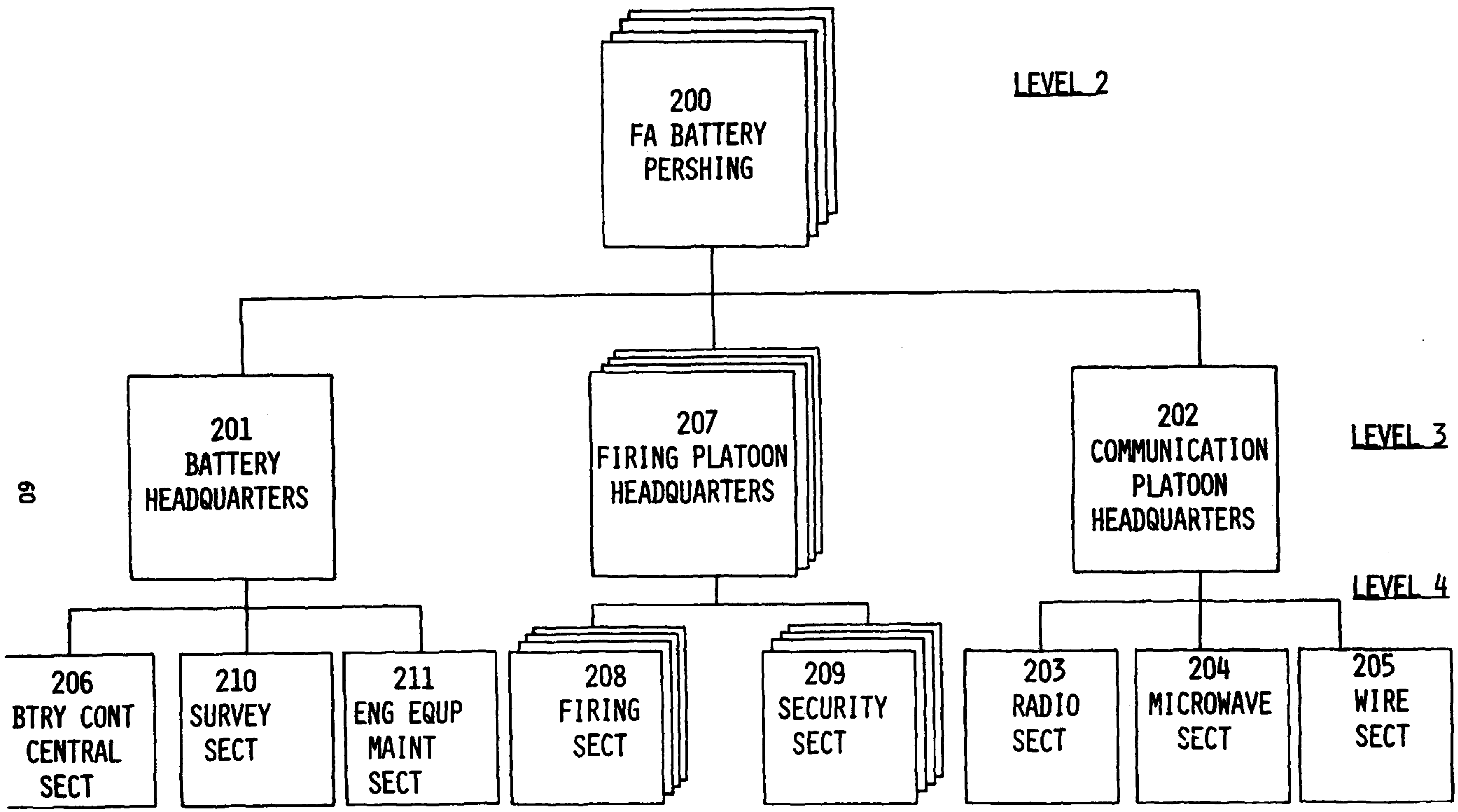


Figure 9. (Cont.)

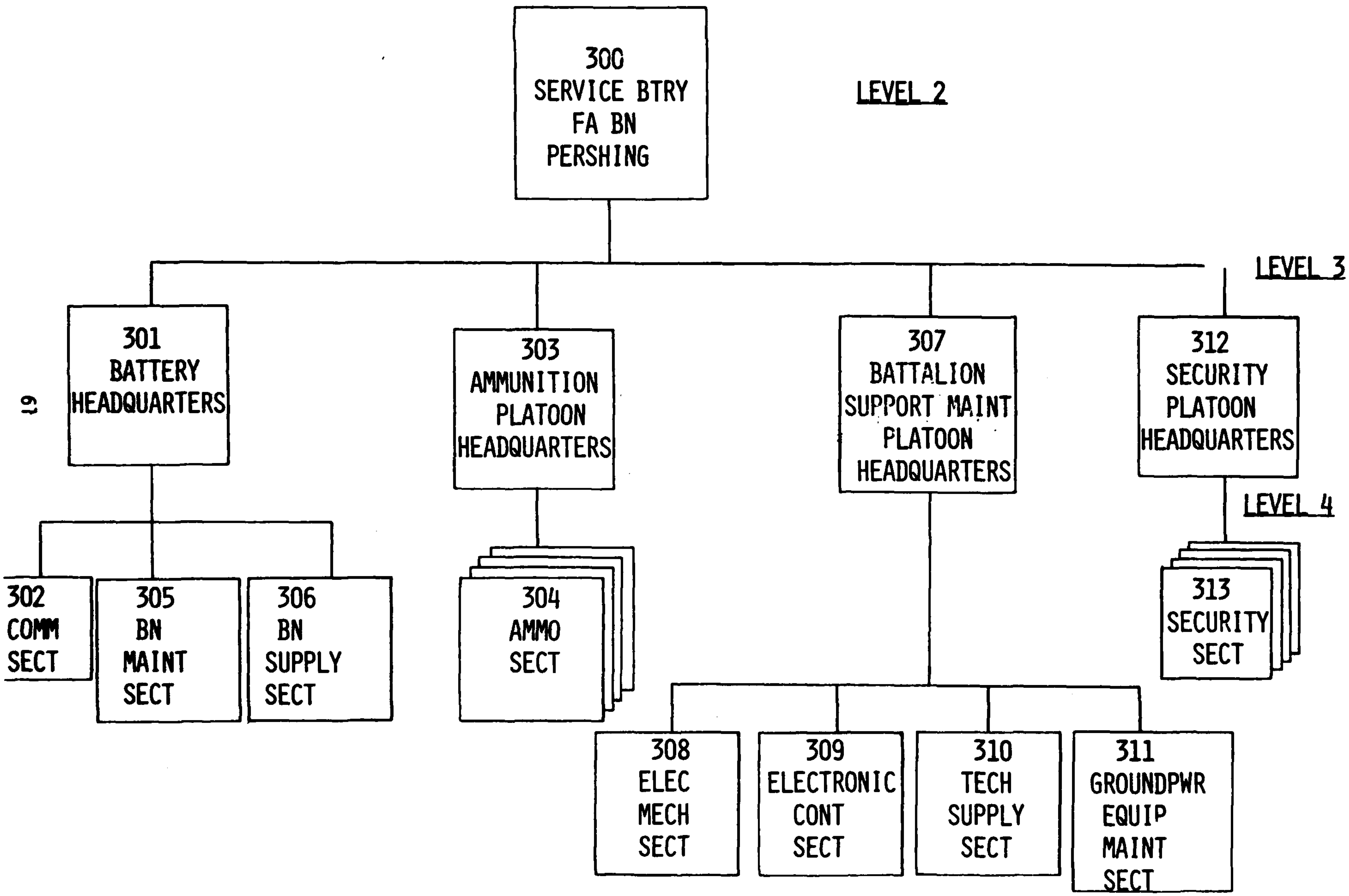


Figure 9. (Cont.)

Table 6. PERSHING MTOE MANPOWER BREAKDOWN

ORGANIZATION	ORG LEVEL	MTOE PARA	PERSONNEL DESCRIPTION	PERSONNEL GRADE	OVERHEAD	DEDICAT-ED	CREW	SUPPORT	MAINT-ENANCE	PAY AND ALLOWANCE PER MAN YR. $	NO. OF PERSONNEL
FA BN PERSHING	1	-	PERSONNEL	in 56th FA	BRIGADE NOT	INCLUDED					
GQ-HQ BTRY	2	100	All PARA'S								
FA BN PERSHING			100s PERSONNEL								
BN HEAD QUARTERS	3	101	BN CMDR	05	X					29804	1
	3	101	DEPUTY CMDR	04	X					29804	1
	3	101	S 1 ADJUNTANT	03	X					18718	1
LIAISON SELT.	4	106	LIAISON SOT	E6		X		X		10469	1
PERSONNEL SELT	4	114	UNIT PERS TECH	WO	X					18080	1
	4	114	PERS SGT	E7	X					16759	1
	4	114	MISC PERS	5-E5s		X		X		10469	5
	4	114	MISC PERS	8-E4s		X		X		10469	8
	4	114	PERS KEC ASST	E3		X		X		7500	1
BN HEAD QUARTERS	3	101	S 3 PLNS, TING OFF	04	X					29804	1
Survey INFO. CENT	4	105	CHIEF SURVEYOR	E7	X					16759	1
	4	105	SURVEY COMPUTER	Q-E5s		X				10469	2
	4	105	RDO TELE OP	E3		X		X		7500	1
BN HEAD QUARTERS	3	101	BN SURGEON	03	X					18718	1
MEDICAL SECT	4	113	SECT SGT	E6	X					10469	1
	4	113	MISC PERS	2-E5s		X				10469	2
	4	113	MISC PERS	15-E4s		X		X		10469	15
BN HEAD QUARTERS	3	101	SIGNAL OFF.	04	X					29804	1
COMM. CENT. SECT	4	108	COMM CENT CH	E6	X					10469	1
	4	108	SHIFT SUPERVISOR	2-E5s		X		X		10469	2

*NOTE: COMPUTED BY LOGAM AS EXPECTED VAUE EXCEPT-FOR OVERHEAD OR

Table 6. PERSHING MTOE MANPOWER BREAKDOWN (CONTD)

ORGANIZATION	ORG LEVEL	MTOE PARA	PERSONNEL DESCRIPTION	PERSONNEL GRADE	OVERHEAD	DEDICAT-ED	CREW	SUPPORT	MAINT-ENANCE	PAY AND ALLOWANCE PER MAN YR. $	NO. OF PERSONNEL
COMM CENT. SECT CONT											
	4	108	MISC. PERS	9-E4s		X		X		10469	9
	4	108	MESSENGER	2-E3s		X		X		7500	2
OTHER OH PERS	3	101	S 4	04	X					29804	1
	3	101	MISS. MAINT ST. OFF	04	X					29804	1
	3	101	BN MOTOR OFF	03	X					18718	1
	3	101	CHAPLIN	03	X					18718	1
	3	101	LIAISON OFF	03	X					18718	1
	3	101	RECON & SURVEY OFF	03	X					18718	1
	3	101	S 2	03	X					18718	1
	3	101	SGT MAJOR	E9	X					16759	1
	3	101	CAREER COUNSEL	E7	X					16759	1
BATTERY HQ	3	102	BTRY CMDR	03	X					18718	1
	3	102	EXEC OFF	02	X					18718	1
	3	102	FIRST SGT	E8	X					16759	1
	3	102	MESS STEWARD	E7		X		X		16759	1
	3	102	MISC PERS	3-E6s		X		X		10469	3
	3	102	MISC PERS	3-E5s		X		X		10469	3
	3	102	SR VEH RPIMN	E5					X	------	--
	3	102	SRMP PWRGEN OP/MEC	E5					X	------	--
	3	102	MISC PERS	13-E4s		X		X		10469	13
	3	102	WH VEH RPMN	E4					X	------	--
	3	102	MISC PERS	4-E3s		X		X		7500	4
ADMIN SECT	4	103	PERS STAFF NCO	E6	X					10469	1
	4	103	MISC PERS	2-E5s		X		X		10469	2
	4	103	MISC PERS	2-E4s		X		X		10469	2
	4	103	MISC PERS	3-E3s		X		X		7500	3

Table 6. PERSHING MTOE MANPOWER BREAKDOWN (CONTD)

ORGANIZATION	ORG LEVEL	MTOE PARA	PERSONNEL DESCRIPTION	PERSONNEL GRADE	OVERHEAD	DEDICATED	CREW	SUPPORT	MAINTENANCE	PAY AND ALLOWANCE PER MAN YR. $	NO. OF PERSONNEL
OP. 411TEL PLAT. HQ	3	104	ASSISTANT S 3	3-03s	X					18718	3
	3	104	OP. SGT	E8	X					16759	1
	3	104	INTEL SGT	E8	X					16759	1
	3	104	MISC PERS	4-E5s		X		X		10469	4
	3	104	MISC PERS	6-E4s		X		X		10469	6
	3	104	RDO TELE OP	E3		X		X		7500	1
COMM PLAT HQ	3	107	COMM PLAT LDR	02	X					18718	1
	3	107	COMM CHIEF	E8	X					16759	1
	3	107	LT VEH DYR	E3		X		X		7500	1
WIRE SECT.	4	109	WIRE FOREMAN	E6	X					10469	1
	4	109	WIRE TEAM CH	3-E5s		X		X		10469	3
	4	109	MISC PERS	4-E4s		X		X		10469	4
	4	109	MISC PERS	10-E3s		X		X		7500	10
RADIO SECT	4	110	UWRD 5 SEC CH	E7	X					16759	1
	4	110	MISC PERS	8-E5s		X		X		10469	8
	4	110	MISC PERS	13-E4s		X		X		10469	13
	4	110	MISC PERS	13-E3s		X		X		7500	13

Table 6. PERSHING MTOE MANPOWER BREAKDOWN (CONTD)

ORGANIZATION	ORG LEVEL	MTOE PARA	PERSONNEL DESCRIPTION	PERSONNEL GRADE	OVERHEAD	DEDICAT-ED	CREW	SUPPORT	MAINT-ENANCE	PAY AND ALLOWANCE PER MAN YR. $	NO. OF PERSONNEL
FIELD ARTY.	2	200	ALL PARA's								
BTRY-PERSHING			200s PERSONNEL								
BTRY HQ	3	201	BTRY CMDR	4-04s	X		X			29804	4
	3	201	EXEC OFFICER	4-03s	X		X			18718	4
	3	201	FIRST SGT	4-E8s		X		X		16759	4
	3	201	MISC PERS	8-E7s		X		X		16759	8
	3	201	MISC PERS	8-E6s		X		X		10469	8
	3	201	SRWH VEH REPMAN	4-E5s					X	-----	-
	3	201	MISC PERS	20-E5s		X		X		10469	20
	3	201	WH VEH REPMN	16-E4s					X	-----	-
	3	201	ARMORER	4-E4s					X	-----	-
	3	201	MISC PERS	3-E4s		X		X		10469	3
	3	201	WH VEH APPRENTICE	8-E3s					X	-----	-
	3	201	MISC PERS	16-E3s		X		X		7500	16
BTRY CONT. CENT. SECT	4	206	OPERATIONS SGT	4-E7s	X		X			16759	4
	4	206	ASST. OP. SGT	8-E6s		X	X			10469	8
	4	206	OPS. ASSISTANT	12-E4s		X	X			10469	12
	4	206	RDO TELEPHONE OP	8-E3s		X		X		7500	8
SURVEY SECT.	4	210	RECON & SURVEY OF	4-02s	X					18718	4
	4	210	CH OF SURVEY PART	4-E6s	X					10469	4
	4	210	SURVEY COMPUTER	8-E5s		X		X		10469	8
	4	210	INSTRUMENT OPR	8-E4s		X		X		10469	8
	4	210	MISC PERS	12-E3s		X		X		7500	12

Table 6. PERSHING MTOE MANPOWER BREAKDOWN (CONTD)

ORGANIZATION	ORG LEVEL	MTOE PARA	PERSONNEL DESCRIPTION	PERSONNEL GRADE	OVERHEAD	DEDICAT-ED	CREW	SUPPORT	MAINT-ENANCE	PAY AND ALLOWANCE PER MAN YR. $	NO. OF PERSONNEL
ENG EQUIP. MAINT. SECT.	4	211	ENG. MSL. REP. SUPV.	4-E6S		X			X	40469	4
	4	211	SR. MP PWR GEN OP/MEC	4-E5S					X	-	-
	4	211	ENGR MSL.EQUIP.MECH.	4-E4S					X	-	-
	4	211	MP PWR.GEN. OP/MECH.	16-E4S					X	-	-
	4	211	POW PACK SPECIALIST	8-E4S					X	-	-
FIRING PLAT. HQ	3	207	PLATOON CMDR	12-03S	X		X			18718	12
	3	207	ASST.PLAT. CMDR.	12-02S	X		X			18718	12
	3	207	MSL. MNT. TECH.	12-WOS		X			X	18080	12
	3	207	PLATOON SGT.	12-E7S	X		X			16759	12
	3	207	PERSH. MAINT SUP.	12-E7S		X			X	16759	12
	3	207	WRECKER OPR.	12-E4S		X	X	X		10469	12
	3	207	RDO TELEP. OPER.	24-E3S		X	X	X		7500	24
FIRING SECTIONS	4	208	SECTION CHIEF	12-E6S	X		X			10469	12
	4	208	ASST. SECT. CHIEF	36-E5S		X	X			10469	36
	4	208	MISC. PERS.	84-E5S		X	X			10469	84
	4	208	MISC. PERS.	144-E4S		X	X			10469	144
	4	208	MISSILE CREW MN	24-E3S		X	X			7500	24
SECURITY SECTION	4	209	SECTION CHIEF	12-E6S	X		X			10469	12
	4	209	ASST.SECT.CHIEF	12-E5S		X	X			10469	12
	4	209	SR. SECURITY GRD	12-E4S		X	X			10469	12
	4	209	SECURITY GUARD	132-E3S		X	X			7500	132
COMM. PLAT. HQ.	3	202	COMMUNICAT. OFF.	4-02S	X		X			18718	4
	3	202	COMM. CHIEF	4-E7S		X	X			16759	4
	3	202	FLD RADIO MECH.	8-E4S			X		X	—	—
	3	202	TT OPERATOR	12-E4S		X	X			10469	12

Table 6. PERSHING MTOE MANPOWER BREAKDOWN (CONTD)

ORGANIZATION	ORG LEVEL	MTOE PARA	PERSONNEL DESCRIPTION	PERSONNEL GRADE	OVERHEAD	DEDICATED	CREW	SUPPORT	MAINTENANCE	PAY AND ALLOWANCE PER MAN YR. $	NO. OF PERSONNEL
RADIO SECT.	4	203	CH. RADIO OPR.	12-E5S		X	X			10469	12
	4	203	SR. RADIO OPR.	12-E4S		X	X			10469	12
	4	203	RADIO OPR	24-E3S		X	X			7500	24
MICROWAVE SECT.	4	204	TEAM CHIEF	4-E5S		X	X			10469	4
	4	204	TAC MW SYS REP MAN	4-E5S					X	-	-
	4	204	SR PERSH.COMM SP	4-E4S		X	X			10469	4
	4	204	PERSH. COMM SP	4-E3S					X	-	-
WIRE SECT.	4	205	MISC. PERS.	8-E4S		X	X			10469	8
	4	205	MISC PERS	20-E3S		X	X			7500	20
SERVICE BTRY	2	300	ALL PARA'S								
FA RN PERSHING			300 S PERSONNEL								
BATTERY HQ	3	301	BTRY CMDR	04	X					29804	1
	3	301	EXECU. OFF.	03	X					18718	1
	3	301	FIRST SGT.	E8		X			X	16759	1
	3	301	MISC PERS.	2-E7S		X		X		16759	2
	3	301	MISC PERS.	2-E6S		X		X		10469	2
	3	301	MISC PERS.	5-E5S		X		X		10469	5
	3	301	SR MP PWR GEN OP/MECH	2-E5S					X	-	-
	3	301	SR VEH RPMAN	2-E5S					X	-	-
	3	301	ARMORER	E4					X	-	-
	3	301	MISC PERS	8-E4S		X		X		10469	8
	3	301	ENG MSL MECH	E4					X	-	-
	3	301	MP PWR GEN OP/MECH	4-E4S					X	-	-
	3	301	POW PACK SP	E4					X	-	-
	3	301	WH VEH REPMAN	4-E4S					X	-	-
	3	301	WH VEH PPM REPMAN	2-E3S					X	-	-
	3	301	MISC PERS	4-E3S		X		X		7500	4

Talbe 6. PERSHING MTOE MANPOWER BREAKDOWN (CONTD)

ORGANIZATION	ORG LEVEL	MTOE PARA	PERSONNEL DESCRIPTION	PERSONNEL GRADE	OVERHEAD	DEDICAT-ED	CREW	SUPPORT	MAINT-ENANCE	PAY AND ALLOWANCE PER MAN YR. $	NO. OF PERSONNEL
COMM SECT	4	302	COMM. CHIEF	E5		X		X		10469	1
	4	302	FLD RDO MECH	E4					X	-	-
	4	302	MISC PERS	6-E4S		X		X		10469	6
	4	302	MISC PERS	4-E3S		X		X		7500	4
BN MAINT. SECT.	4	305	AUTMV MAINT. TECH.	WO	X				X	18080	1
	4	305	MOTOR MAINT SGT	E8	X				X	16759	1
	4	305	ASST MO MAINT SGT	E7		X			X	16759	1
	4	305	SR MP PWR GEN OP/MECH	2-E5S					X	-	-
	4	305	SR VEH REPMN	2-E5S					X	-	-
	4	305	ENG MSL EQUIP MEC	E4					X	-	-
	4	305	MP PWR GEN OP/MECH	4-E4S					X	-	-
	4	305	POW PACK SPECH.	2-E4S					X	-	-
	4	305	WH VEH REPMN	13-E4S					X	-	-
	4	305	WELDER	E4					X	-	-
	4	305	MISC PERS	3-E4S		X		X		10469	3
	4	305	WH VEH REPARMN	3-E3S					X	-	-
BN SUPPLY SECT	4	306	UNIT SUP. TECH.	WO	X					18080	1
	4	306	SUPPLY SGT	E7	X					16759	1
	4	306	ASST. SUPPLY SGT	E6		X		X		10469	1
	4	306	MISC PERS	3-E5S		X		X		10469	3
	4	306	MISC PERS	6-E4S		X		X		10469	6
	4	306	MISC PERS	8-E3S		X		X		7500	8
AMMO PLAT. HQ	3	303	AMMO OFF.	02	X					18718	1
	3	303	PLAT SGT	E7	X					16759	1
	3	303	AMMO AGENT	E4		X		X		10469	1
	3	303	RDO TELEPH OPR	E3		X		X		7500	1

Table 6. PERSHING MTOE MANPOWER BREAKDOWN (CONTD)

ORGANIZATION	ORG LEVEL	MTOE PARA	PERSONNEL DESCRIPTION	PERSONNEL GRADE	OVERHEAD	DEDICAT-ED	CREW	SUPPORT	MAINT-ENANCE	PAY AND ALLOWANCE PER MAN YR. $	NO. OF PERSONNEL
AMMO SECT	4	304	SECT CHIEF	4-E5s		X		X		10469	4
	4	304	MISC PERS	16-E4s		X		X		10469	16
	4	304	MISL HANDLER	12-E3s		X		X		7500	12
BN. SPT. MAINT PLAT HQ	3	307	PLATOON LDR	03	X				X	18718	1
	3	307	ASST PLAT LDR	02	X				X	18718	1
	3	307	MAINT CHIEF	E8	X				X	16759	1
	3	307	BM GUID/CONT REPSUPV	E7		X			X	16759	1
	3	307	BM DIG EQINS	3-E6s					X	-----	-
	3	307	BM ELEC-MECH INS	3-E6s					X	-----	-
	3	307	GUID-CON SP	E5					X	-----	-
	3	307	BM ELEC-CON INSP	3-E6s					X	-----	-
	3	307	MISC PERS	4-E4s		X		X		10469	4
	3	307	ASST GUID-CON SP	E4					X	-----	-
	3	307	REPAIR PTS CLERK	2-E3s		X		X		7500	2
ELEC. MAINT SECT	4	308	BM MAINT TECH	WO	X				X	18080	1
	4	308	BM GIU-CON REP SECTION	E7					X	-----	-
	4	308	BM ELEC-MECH REPMN	14-E4s					X	-----	-
	4	308	BM REP APPREN	7-E3s					X	-----	-
	4	308	WRECKER OPR	E4		X		X		10469	1
ELEC CONT SECT	4	309	BM MAINT TECH	2-WOs	X				X	18080	2
	4	309	MISC SUPV	3-E7s		X		X		16759	3
	4	309	BM DIG EQ REP FMA	E6					X	-----	-
	4	309	BM GUID-CON REPPMAN	2-E6s					X	-----	-
	4	309	SR BM DIG EQ RPMN	9-E5s					X	-----	-
	4	309	BM DIG EQ REPMN	3-E4s					X	-----	-
	4	309	BM GUID-CON REPMN	5-E4s					X	-----	-
	4	309	MISC APPRENTICE	6-E4s					X	-----	-

Table 6. PERSHING MTOE MANPOWER BREAKDOWN (CONTD)

ORGANIZATION	ORG LEVEL	MTOE PARA	PERSONNEL DESCRIPTION	PERSONNEL GRADE	OVERHEAD	DEDICAT-ED	CREW	SUPPORT	MAINT-ENANCE	PAY AND ALLOWANCE PER MAN YR. $	NO. OF PERSONNEL
TECH SUPPLY SECT	4	310	UNIT SUPPLY TECH	WO	X					18080	1
	4	310	REP PARTS SURV	E6		X		X		10469	1
	4	310	MISC PARTS PERS	5-E5s		X		X		10469	5
	4	310	MISC PARTS PERS	9-E4s		X		X		10469	9
	4	310	REP PARTS CLERK	E3		X		X		7500	1
GN PNR EQ MAINT SECT	4	311	ENG EQ RPRTEC	2-WOs	X				X	18080	2
	4	311	ENG MSL RPR SUPV	E7	X				X	16759	1
	4	311	REPR FOREMAN	2-E6s		X			X	10469	2
	4	311	MACHINIST	2-E5s					X	-----	-
	4	311	POW GENEQ RPM	7-E5s					X	-----	-
	4	311	SR ENEMSL EQ SP	E5					X	-----	-
	4	311	SR SP ELDEVICE RPM	2-E5s					X	-----	-
	4	311	SR WELDER	E5					X	-----	-
	4	311	ENG MSL EQ SP	E4					X	-----	-
	4	311	PWR GENE QRPM ASST	3-E4s					X	-----	-
	4	311	PWR PACK SPEC	2-E4s					X	-----	-
	4	311	SPELDEVICE RPM	E4					X	-----	-
	4	311	TOPO INT RPM	E4					X	-----	-
	4	311	WELDER	E4					X	-----	-
SECURITY PLAT HQ	3	312	PLATOON CMDR	02	X					18718	1
	3	312	PLATOON SGT	E7		X		X		16759	1
	3	312	RDO TELEPH OPR	E3		X		X		7500	1
SECURITY SECTIONS	4	313	SECTION CHIEF	4-E6s		X		X		10469	4
	4	313	ASST SECT CHIEF	4-E5s		X		X		10469	4
	4	313	MACHINE GUNNER	8-E4s		X		X		10469	8
	4	313	RDO TELEPH OPR	8-E3s		X		X		7500	8
	4	313	SECURITY GOARD	24-E3s		X		X		7500	24

Table 7. Radio Sets (Pershing MTOE)

Equip.LIN No.	Nomenclature	MTOE Total Quantity Per BN
Q33089	Radio Set: AN/GRC-106 Truck Mtd - 1 1/4 Ton	7
Q34158	Radio Set: AN/GRC-126 Utility Truck Mtd - 1 1/4 Ton Cargo	12
Q38335	Radio Set: AN/PRC-90	8
Q53001	Radio Set: AN/VRC-46	6
Q53926	Radio Set: AN/VRC-46 Truck Mtd - 1/4 Ton	27
Q53944	Radio Set: AN/VRC-46 Truck Mtd - 1 1/4 Ton Utility	16
Q54618	Radio Set: AN/VRC-47 Truck Mtd 1/4 Ton	9
Q78282	Radio Set Control Group: AN GRA-39	27

Table 8. Trucks (Pershing MTOE)

Equip.LIN No.	Nomenclature	MTOE Total Quantity Per BN
X39883	Truck Cargo: 1 1/4 Ton 4 x 4 W/E	52
X40009	Truck Cargo: 2 1/2 Ton 6 x 6 W/E	102
x40831	Truck Cargo: 5 Ton 6 x 6 LWB W/E	17
x41105	Truck Cargo: 5 Ton 6 x 6 LWB W/E	60
x41310	Truck Cargo: 5 Ton 8 x 8 W/E	22
x59505	Truck Tractor: 5 Ton 8 x 8 W/Winch W/E	47
x60833	Truck Utility: 1/4 Ton 4 x 4 W/E	47
X 477	Truck Van: Shop 2 1/2 Ton 6 x 6 W/Winch W/E	9
[illegible]299	Truck Wrecker: 5 Ton 6 x 6 W/Winch W/E	22

Table 9. Example of LOGAM Input Array for Maintenance Manpower Costs When O&S Costs are Based on TOE Structure for Field Radios

Equip.LIN No.	Annual Pay and Allowances and No. of Manpower Grades Maintenance Equipment[4]								
	$7500			$10469			$16759		
	E1	E2	E3	E4	E5	E6	E7	E8	E9
Q33089				X	X				
Q34158				X	X				
Q38335				X	X				
Q53001				X	X				
Q53926				X	X				
Q53944				X	X				
Q54618				X	X				
Q78282				X	X				

(4) Field Level Maintenance - Organizational/Direct support input to LOGAM maintenance program is therefore $10469 for maintenance manpower at the Equipment level of Direct Support

Table 10. Example of LOGAM Input Array for Maintenance Manpower Costs When O&S Costs are Based on TOE Structure for Trucks

Equip.LIN No.	Annual Pay and Allowances and No. of Manpower Grades Maintenance Equipment (5)								
	$7500			$10469			$16759		
	E1	E2	E3	E4	E5	E6	E7	E8	E9
X39883			X	X					
X40009			X	X	X				
X40831			X	X	X				
X41105			X	X					
X41310			X	X					
X59505			X	X					
X60833			X	X	X				
X62477			X	X					
X63299			X	X	X				

(5) Field Level Maintenance - Organization/Direct Support input to LOGAM maintenance program are therefore $8985 for maintenance manpower at the Equipment level or Direct Support for LINs X39883, X41105, X41310, X59505 and X62477 and $9479 for maintenance manpower at the Equipment level or Direct Support for LINs X40009, X40831, X60833 and X63299.

Manpower costs for higher levels (General Support and Depot) must be determined from other sources in this example.

In Table 9, only E-4 and E-5 grades are shown performing field level maintenance for the deployed radio sets. The LOGAM manpower input cost factors referred to above are, therefore $10469.

In Table 10, however, E-3, E-4 and E-5 grades are involved in the performance of the field level maintenance of the various trucks as extracted from the Pershing MTOE. For the truck maintenance involving grades E-3 and E-4 only, a straight numerical average of the two annual pay and allowances or $8985 provides the required inputs to the LOGAM program. For the truck maintenance involving grades E-3, E-4 and E-5, a weighted average based on one E-3 and twice the E-4/E-5 pay and allowances or

$$\frac{7500 + 2 \times 10469}{3} = \$9479$$

is used to arrive at the annual field manpower cost inputs for the LOGAM program.

To establish other LOGAM logistics maintenance inputs for the equipment under analysis, the equipments will be treated as LRUs and it is suggested that LRU data forms be completed prior to keypunching. Examples of these data forms are shown in Table 11.

5.4 INDIRECT PAY AND ALLOWANCES (3.013)

This cost element includes base pay and allowances for theater military personnel who are not crew or maintenance personnel such as batallion/company/division commander or other overhead/dedicated support personnel. It includes the costs of persons in those units (batteries, platoons, sections, etc.) which exist only because of the system/organization being costed. The annual costs for Indirect Personnel is obtained from data array made from a table such as Table 6. This includes both overhead and dedicated/support personnel and the product of their annual pay and allowances times the numbers of applicable personnel times the operational life cycle (years) to obtain the total cost for Indirect Pay and Allowances (3.013) to be identified and included in the total O&M cost summation.

5.5 PERMANENT CHANGE OF STATION COST (3.014)

Permament Change of Station Cost (PCS) relates to the cost of replacement personnel to and from overseas theaters and within CONUS. LOGAM recognizes that change of station factors and rates are different for enlisted personnel and officers and are not necessarily sensitive to grade level. This then reduces to two cost estimating relationships (CERs):

Table 11.

LRU DATA FORM NO. 1

SYSTEM________________ DATE________________

LRU	CUP	CMP	CPP	MTBF	MTBR	E	P	PP	EE	REPEAT	CEND	CPE	MAINT.POLICY		
	$	$	$	OP HR	KxMTBF	$\frac{1}{MTBR}$					$	$			

Table 11. (Cont'd)

LRU DATA FORM NO. 2

SYSTEM________________ DATE________________

LRU	WU	WM	WP	CUBEU	CUBEM	CUBEP	TRC	TC	TE	TER	TF	TFR	TMO	TMOR	TI	TIR	TMI	TMIR
	LBS	LBS	LBS	CU FT	CU FT	CU FT	HRS	HRS	HRS	HRS	HRS	HRS	HRS	HRS	HRS	HRS	HRS	HRS

Table 11. (Cont'd)

SYSTEM________ LRU DATA FORM NO. 3 DATE________

LRU	TD	TDR	TMD	TMDR	CLRUPG	CMODPG	CPUBII	CKIT	WTKIT	ZI	ZO	OTF	SPE		
	HRS	HRS	HRS	HRS	$	$	$	$	LBS						

Table 11. (Cont'd)

SYSTEM______________ LRU DATA FORM NO. 4 DATE______________

LRU	TMOD	TMID	TMDD	TOMW	TIMW	TDMW	FNGF	FNSP							
	HRS	HRS	HRS	HRS	HRS	HRS									

PCSE* = (QEPD + QEPM) * EPCSR * EPCSC * YR
PCSO = QO * OPCSR * OCPCS * YR
PCS = PCSE + PCSO

* Input mnemonics and operational cost element definitions are given later in this Appendix.

5.6 POL COST (3.022)

POL cost CPOL includes the system costs associated with the consumption of fuel and lubricants for a TOE line item (LIN). The CER for each line item that uses POL is of the following form:

CPOL = QLIN * AULIN * RFU * CF * FOL * YR

The program will then accumulate the POL costs for all applicable line items for the system being costed. A hardware array is introduced here to identify the LINs which use POL and the associated factors in the CPOL equation.

5.7 UNIT TRAINING, AMMUNITION AND MISSILES (3.023)

Unit training, ammunition and missiles includes the cost of ammunition and missiles comsumed by the system being costed during unit training. Excluded is the cost of ammunition consumed during small arms qualification.

When dealing with ammunition, a CER of the following form applies:

CAMMO = (CATAM + CAIAM + CARSUA + CAAPLA) YR

In general when dealing with missiles, there are two types of missile firings that are costed:

ARTY-ORD firings - CARORD
Follow-on Operational Test FOT firings - CFOT

and these result in two CERs as follows:

CARORD = (CATAO + CAMIAO + CARSUO + CACSAO + CAAPLO) * YR

CFOT = (CATFOT + CAPFOT + CAIFOT + CARSUF + CACSFO + CAAPLF) * YR

CATAO = CTEAO * FPYAO

CAMIAO(1) = (Σ of cost of installing instrumentation in each missile stage/section) * FPYAO

CARSUO = (CGRSAO + CRUFAO) * FPYAO

(1) NOTE: Summation may be developed in computer programs as an input hardware array.

CACSAO = CCSFAO * FPYAO

CATFOT = CTEFOT * FPYFOT

CAPFOT = COPFOT * FPYFOT

CAIFOT = (Σ of the cost of installing instrumentation in each missile stage/section) * FPYFOT

CARSUF = (CGRSFO + CERUFO) * FPYFOT

CACSFO = CCSFOT * FPYFOT

5.8 MAINTENANCE CIVILIAN LABOR COST (3.051)

Generally, there will be civilian missile maintenance technicians associated with the cost of missile maintenance. This will be of an advisory capacity over and above the cost of military maintenance manpower at GS or Depot. To account for this, the former LOGAM productivity factors will be increased prior to their selection as inputs for the maintenance manpower cost calculations. This operation, if applicable, will be performed outside the program and the inputs effected are the following:

TGMAN
TGRMAN
TDPMI
TDPMII
TDPRI
TDPRII

5.9 OTHER DIRECT (3.052)

This element is a flexible category which can be defined to include any direct operating and support cost not included elsewhere. An example is civilian contractor maintenance for electric power for the system.

An equation of the following form will be added:

ODIR = CAOD * YR

5.10 PERSONNEL REPLACEMENT (3.061)

This element includes the cost of training replacements including pay and allowances for trainees and instructors. Personnel replacement also includes recruiting costs for enlisted personnel, costs of in-processing and initial outfitting, and separation costs. Maintenance enlisted personnel replacements are excluded since they are accounted for in the maintenance cost analysis portion of LOGAM.

LOGAM recognizes differences between personnel replacement costs for enlisted personnel and officers. LOGAM also permits differences between crew enlisted personnel and other enlisted personnel which exist only because of the system being costed.

5.10.1 Crew and Other Overhead/Dedicated Enlisted Personnel Replacement Costs - CCEPRC

The equation for enlisted personnel replacement cost is as follows:

CDEPRC = CEPRC + ODEPRC

In the following equations, the numbers of enlisted personnel CEP (number of crew enlisted personnel) and OEPLC (number of organizational enlisted personnel less crew) are obtained from the data array made from a table such as Table 9 which, in turn, is based on the TOE being evaluated.

CEPRC = CEP * ARCEP * CRCEP * YR
ODEPRC = OEPLC * AROEP * CROEP * YR

5.10.2 Personnel Replacement Cost for Officers/Warrant Officers-RCO

The equation for officers/WOS replacement cost is as follows:

RCO = CORC + OORC

In the following equations, the number of oprational crew officers, OCO, and the number of organizational/overhead officers/WO less crew OOLC are obtained from the data array made from a table such as Table 9 which, in turn, is based on the TOE being evaluated.

CORC = OCO * ARCOO * CRCOO * YR
OORC = OOLC * AROO * CROO * YR

5.11 TRANSIENTS, PATIENTS, PRISONERS COSTS - CTPP (3.062)

This element includes the pay and allowances for personnel added to the Army strength over and above the table of organization and equipment/table of distribution and allowances (TOE/TCA) spaces. This arises because on permament change of station between units a soldier is accounted for as a transient. Similar accounting provides for long-term hospital cases and for prisoners comitted to the Retraining Brigade or the Displinary Barracks. Included in CTPP are the following types of personnel:

Annual cost for dedicated organizational personnel.
Annual cost for maintenance personnel.
Annual cost for crew personnel.

The total cost for TPP is the sum of these

CTPP = (CTPPD + CTPPM + CTPPC) YR

where

$$\mathrm{CTPPD} = (\mathrm{PADO} * \mathrm{TPPFO}) + (\mathrm{PADOEM} * \mathrm{TPPFE})$$
$$\mathrm{CTPPM} = (\mathrm{PADOM} * \mathrm{TPPFO}) + (\mathrm{PADMEM} + \mathrm{CMPT} \div \mathrm{YR})\ \mathrm{TPPFE}$$
$$\mathrm{CTPPC} = (\mathrm{PADOC} * \mathrm{TPPFO}) + (\mathrm{PACEM} * \mathrm{TPPFE})$$

5.12 QUARTERS, MAINTENANCE AND UTILITIES - QMU (3.063)

This element includes the cost of maintenance and utilities for personnel living in Government owned quarters (family quarters, bachelor offficers quarters/bachelor enlisted quarters (BOQ/BEQ), and barracks). The CER for this cost element is of the following form:

$$\mathrm{CQMU} = \mathrm{CQMUO} + \mathrm{CQMUE}$$

where

$$\mathrm{CQMUO} = \mathrm{QO} * \mathrm{ACQMUO} * \mathrm{YR}$$
$$\mathrm{CQMUE} = (\mathrm{TNEM} + \mathrm{CMPT} \div \mathrm{YR}) * \mathrm{ACQMUE} * \mathrm{YR}$$

5.13 MEDICAL SUPPORT COST - SCM (3.064)

This element includes the variable cost of medical and dental support rendered to military personnel. The CER for this cost element is of the following form:

$$\mathrm{SCM} = (\mathrm{QO} + \mathrm{QEPD} + \mathrm{QEPM}) * \mathrm{AMSC} * \mathrm{YR}$$

5.14 OTHER INDIRECT COST - OIC (3.065)

This element is a flexible category which can be defined to include any indirect operating and support costs not included elsewhere. Such costs will differ from system to system. This element includes the cost of general supplies to the force units which exist solely because of the system being costed. This element also includes any identifiable transportation cost (other than to and from Depot maintenance), such as special transportation of tracked vehicles to and from training areas and transportation of repair parts, secondary items, POL and ammunition. The cost of Program Offices or Product Improvement Offices if they exist is also included here. The cost of ammunition for small arms qualification is included. An equation of the following form is included to accommodate the operational OIC cost element:

$$\mathrm{OIC} = \mathrm{AOIC} * \mathrm{YR}$$

5.15 OPERATIONAL AND SUPPORT COST SUMMATIONS

All operational cost elements discussed in the previous paragraphs of this section are tallied separately and included in the LOGAM output format as the summation of all oprational costs.

Support (maintenance) costs are provided in an output format similar to LOCAM 5.

Finally the operational and support cost are summed to produce the grand total O and S costs as estimated by the application of the LOGAM program.

5.16 THE POST PROCESSOR

After all processing of the maintenance data is complete (and the presence of the NU = -4 is recognized) the program examines the value of the input IOPER. If the value of this input is 1 the program calls upon the subroutine OPER to compute the operational costs of the theater being examined. Note that this mode of operation is valid only when a single theater is being examined since the costs and manpower values computed by LOGAM for the theater must be available to the postprocessor.

In addition to the values computed by LOGAM the postprocessor requires additional inputs. These inputs also will be in the form of a NAMELIST, but no mnemonics are required. Rather, the first card identifies the data as before with a &TOE in columns 2 through 5. The following card identifies only the first variable of this list. The inputs on each card must be 10 with zeros used as inputs where the variable is not to be used. The second card of the deck has a string of 10 numbers such as: T = 1.,0.,5.,1.,0.,0.,0.,0.,0.,60000.,

The "T=" appears only on the first data card. The meaning of each value is determined by the position of the input in the string and the values of the first (and in some cases the second) item in the string of inputs of each card. In the above example the initial 1. value identifies the following data to be extracted from the table of organization as shown in Table 12.

The possible inputs and the sequence in which they must be presented to the program are as follows:

Value of First	Value of Second	Meaning Of The Following Data Presented On The Same Card
1	N/A	Personnel date from the TOE
2	1	Personnel cost multipliers, list 1
2	2	Personnel cost multipliers, list 2
2	3	Personnel cost multipliers, list 3
3	N/A	Equipment/Fuel usage data
4	N/A	Ammunition usage data
5	N/A	Instruments/Missiles
6	1	Arty/Ord inputs
6	2	Follow-on training inputs
7	N/A	Signals the end of the inputs to the post-processor and the beginning of computation
8	N/A	Causes results to be printed

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2/3

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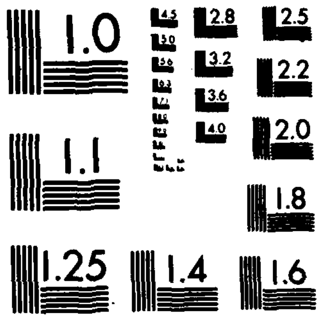

MICROCOPY RESOLUTION TEST CHART
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TABLE 12. THE POSTPROCESSOR INPUTS

FIELD NOS.	I	II	III	IV	V	VI	VII	VIII	IX	X
Type of input										
PERSONNEL COUNT	1.	QTY	OFF/EM	GRADE#	OH	DED.	CREW	SUPT	MAINT	$/MAN/YR
PERS MULT A	2.	1.	EPCSR	EPCSC	CAOD	ARCEP	CRCEP	AROEP	CROEP	AOIC
PERS MULT B	2.	2.	ARCOO	CRCOO	AROO	CROO	TPPFO	TPPFE	ACQMUO	ACQMUE
PER MULT C	2.	3.	OPCSR	OPCSC	AMSC					
FUEL USE	3.	N/A	LIN#	AULIN	RFU	CF	FOL	N/A	N/A	QLIN
AMMUNITION	4.	CATAM	CAIAM	CARSUA	CAAPLA					
INSTRUMENT MISSILES	5.	*	*	*	*	*	*	*	*	*
ARTY/ORD	6.	1.	CTEAO	CAAPLO	CGRSAO	CRUFAO	CCSFAO			FPYAO
FOT	6.	2.	CTEFOT	CAAPLF	CGRSFO	CERUFO	CCSFOT	COPFOT		FPYFOT
TOTAL CONTROL	7.									
PRINT CONTROL	8.									

See Ref I, Table C-8 for explanation of above.

NOTE: SOME DECIMAL NUMBER MUST BE ENTERED FOR EACH OF THE TEN POSSIBLE ENTRIES PER CARD.
WO's are officers so III = 0 and grade = .5

The actual end of the input deck is denoted as with all NAMELIST inputs by a &END in columns 2 through 5 of the last card. The postprocessor computes all of the personnel related costs, petroleum, oil and lubricants costs, unit training costs, and adds the maintenance related costs to arrive at a predictable operating and support cost total.

The O&S cost information is listed in a printout in accordance with Table 2-1 of DA PAM 11-4. Ref. I, Table 12 Explanation of mnemonics meaning and use.

Ref. I, Table 12 Explanation of Mnemonics meaning and use.

The Mnemonics used in Table 12 are for reference only. They are not to be used in inputting data to the postprocessor. Rather, they refer only to this list for the meaning of the field.

MNEMONIC NAME	MEANING OF THE INPUT	TO BE ENTERED IN FIELD	CARD IDENT FIELD I /FIELD II
AMSC	Average annual $/person medical support	V	2/3
ACQMUE	Ave. annual $/enlisted man for quarters	X	2/2
ACQMUO	$/Yr./Officer or warrant/quarters	IX	2/2
AOIC	$/Yr. other indirect cost	X	2/1
ARCEP	Attrition rate/Yr./enlisted crew	VI	2/1
ARCOO	Attritrion rate/Yr./officers crew	III	2/2
AROEP	Attrition rate/Yr./Organization enlisted	VIII	2/1
AROO	Attrition rate/Yr./Organization and overhead officers	V	2/2
AULIN	Annual usage of the TOE LIN that uses POL in operating hours per LIN per year.	IV	3/
CAAPLA	$/Yr. for A.P.L data takers/BN. assoc. with firings. (Ammo.)	V	4/
CAAPLF	$/Yr. for A.P.L data takers/BN. assoc. with follow-on training firings	IV	6/2

CAAPLO	$/Yr. for A.P.L data takers/BN. assoc. with firings (ARTY-ORD firings)	IV	6/1
CAIAM	$/Yr. associated with ammo firings for unit training	III	4/
CARSUA	$/Yr. for range support assoc. with amo firings	IV	4/
CATAM	$/Yr. for ammunition transport	II	4/
CCSFAO	$/Yr. for contractor support for ARTY/ORC firings	VII	6/1
CCSFOT	$/Yr. for contractor support for follow-on training firings	VII	6/2
CERUFO	$/Yr. use of eastern range for follow-on test firings	VI	6/2
CF	Cost of fuel in $/gal. Appears in same line (card or group of 10 as other inputs related to same device or vehicle)	VI	3/
CGRSAO	Cost ($) per ARTY/ORD firing for range support.	V	6/1
CGRSFO	Cost ($) per FOT firing for range support.	V	6/2
COPFOT	Cost ($) per FOT firing for over-seas preparation of missile	VIII	6/2
CRCEP	Replacement cost for a crew enlisted man including training.	VII	2/1
CRCOO	Replacement cost per crew officer/warrant including training	IV	2/2
CROEP	Replacement cost per organizational enlisted man including training	IX	2/1
CROO	Replacement cost per organizational officer/WO including training	VI	2/2
CRUFAO	Cost of range use per ARTY-ORD firing	VI	6/1
CTEAO	Cost of transport per ARTY-ORD firing	III	6/1

CTEFOT	Transportation cost per FOT firing	II	6/2
EPCSC	Permanent change of station cost per enlisted man	IV	2/1
EPCSR	Rate of enlisted permanent change of station (times/yr.)	III	2/1
CREW	Indication of assignment of individual represented by the line (card) to the crew. A "1." value means "crew", a "0." means other assignment.	VII	1/
DED.	A "1." means individual(s) is dedicated, a "0." means not dedicated.	VI	1/
FOL	Fractional increase over fuel use to allow for oil and lube.	VII	3/
FPYAO	No. of ARTY-ORD firings/yr. for this organization.	X	6/1
FPYFOT	No. of FOT firings/yr. for this organization	X	6/2
MAINT	A "1." indicated individual is assigned to maintenance function, a "0." indicates otherwise.	IX	1/
$/Yr.	Pay and allowances per man per year for personnel represented by this line.	X	1/
SUPT	A "1." indicates individual is assigned to the support.	VIII	1/
QYT	The number of people represented by this line.	II	1/
OFF/EM	A "0." indicates line represents an officer or warrant officer, a "1." represents enlisted personnel.	II	1/
GRADE	A numerical (real number) representation of the grade of the people represented by the line (.5 represents warrant officer).	IV	1/

OPCSC	Permanent change of station cost per officer/WO.	IV	2/3
OPCSR	Rate (no. per yr.) of change of station for officers/WO	III	2/3
QLIN	The quantity of the TOE line item using the fuel	X	3/
RFU	Rate (gal. per hr.) of usage of the fuel by each of the devices using the fuel and represented by the entry.	V	3/
*	This entry (entries) provides a means of specifying the instrumentation costs incurred in firing a missile. Nine entries are possible. They will be added by the program. The line represents a type of missile.	II thru X	5/
LIN#	This provides an opportunity to enter a number identifying the line item of the TOE.	III	3/
OH	A "1." indicates that the people identified by the entry are to be considered as overhead. A "0." indicates otherwise.	V	1/
CAOD	$/Yr. for other direct costs of the organization.	V	2/1
TPPFE	Transients, patients and prisoners factor for enlisted men. Used to increase cost on basis of pay and allowances. A fraction	VIII	2/2
TPPFO	Transients, patients and prisoners factor for officers.	VII	2/2

OPERATING COST ELEMENT DEFINITIONS

ACQMUE	Average annual cost per enlisted men for QMU.
ACQMUO	Average annual cost per officer/WO for QMU.
AMSC	Average annual medical support cost per man.
AOIC	Annual other indirect cost.
ARCEP	Average annual attrition rate for crew enlisted personnel.
ARCOO	Average annual attrition rate for oprating crew officers/WOs.
AROEP	Average annual attrition rate for organizational enlisted personnel.
AROO	Average annual attrition rate for organizational/overhead officers/WOs.
AULIN	Annual usage of the TOE LIN that used POL in operating hours per LIN per year.
CAAPLA	Annual cost of APL(1) data takers per BN(2) associated with firings for unit training.
CAAPLF	Annual cost of APL data takers per BN for FOT(3) firings.
CAAPLO	Annual cost of APL data takers per BN for ARTY-ORD firings.
CACSAO	Annual cost of contractor support for ARTY-ORD firings.
CACSFO	Annual cost of contractor support for FOT firings.
CAIAM	Annual instrumentation costs associated with ammunition firings for unit training.
CAIFOT(4)	Annual cost of missile instrumentation per FOT firing = (Σ of the cost of installing instrumentation in each missile stage/section) * FPYFOT

(1) APL Applied Physics Lab.
(2) BN Implies any level 1 organization or system being costed.
(3) FOT Follow-on training.
(4) Summation can be input to program as special hardware array.

CAMIAO(4)	Annual missile instrumentation installation cost per ARTY-ORD firing = (Σ of the cost of installing instrumentation in each missile stage/section) * FPYAO.
CAMMO	Operational life cycle cost for ammunition for the level 1 organization being costed.
CAOD	Annual other direct costs per level 1 organization.
CAPFOT	Annual cost of overseas preparation for FOT firings.
CARORD	Operational life cycle cost of Artillery-Ordnance (ARTY-ORD) firings per level 1 organization.
CARSUA	Annual cost of range support/usage associated with ammunition firings for unit training.
CARSUF	Annual cost of range support/usage for FOT firings.
CARSUO	Annual cost for range support/usage for ARTY-ORD firings.
CATAM	Annual transportation cost for ammunition for the level 1 organization under evaluation.
CATAO	Annual transportation cost for ARTY-ORD firings per BN (level 1 organization).
CATFOT	Annual transportation cost for FOT firings per level 1 organization.
CDEPRC	Crew and other overhead/dedicated enlisted personnel operating life cycle replacement costs.
CCSFAO	Cost of contractor support per ARTY-ORD firing.
CCSFOT	Cost of contractor support per FOT firing.
CEP	Total number of crew enlisted personnel from TOE personnel allowance data.
CEPRC	Crew enlisted personnel operating life cycle replacement costs.
CERUFO	Cost of Eastern range usage per FOT firing.
CF	Cost of fuel, $ per gallon.
CGRSAO	Cost of Government range support per ARTY-ORD firing.
CGRSFO	Cost of Government range support per FOT firing.

CMPT	An output from the logistics support cost portion of the LOGAM program. It is the operational life cycle cost of all maintenance test and repair personnel including associated training costs.
COPFOT	Overseas preparation cost per FOT firing.
CORC	Operating life cycle replacement costs for officers/WOs assigned to crew.
CPOL	Operating life cycle costs for POL for all line items (LINs) that use POL in the system being costed.
CQMU	Cost of maintenance and utilities for personnel living in Government owned quarters.
CQMUE	CQMU for enlisted men.
CQMUO	CQMU for officers/WOs.
CRCEP	Average replacement cost per crew enlisted man including average training cost.
CRCOO	Average replacement cost per crew officer/WO including average training cost.
CROEP	Average replacement cost per organizational enlisted man including average training cost.
CROO	Average replacement cost per organizational/overhead officer/WO including average training cost.
CRUFAO	Cost of range usage per ARTY-ORD firing.
CTEAO	Cost of transportation for each ARTY_ORD firing.
CETFOT	Transportation cost for each FOT firing.
CTPP	Operational life cycle transients, patients and prisoners costs.
CTPPC	Annual transients, patients and prisoners cost for all crew personnel.
CTPPD	Annual transients, patients and prisoners cost for all overhead/dedicated organizational personnel.
CTPPM	Annual transients, patients and prisoners cost for all maintenance personnel.
EPCSC	Enlisted personnel PCS cost per man.
EPCSR	Enlisted personnel annual PCS rate.

FOL	Factor to determine the amount of oil and lubricants used in relation to the fuel usage. This factor is introduced to account for the cost of oil and lubricants in addition to fuel. It is of the form: 1 + a fraction where the fraction is introduced to adjust the POL costs in proportion to annual usage of fuel.
FPYAO	Number of ARTY-ORD firings per year per level 1 organization.
FPYFOT	Number of FOT firings per year per level 1 organization.
OCO	Total number of operating crew officers/WOs from TOE personnel allowance data.
ODIR	Operating life cycle other direct costs.
ODEPRC	Organizational overhead/dedicated enlisted personnel operating life cycle replacement cost.
OEPLC	Total number of organizational enlisted personnel less crew and maintenance personnel from TOE personnel allowance data.
OIC	Operating life cycle other indirect cost element.
OOLC	Total number of operating officers/WOs less crew from TOE personnel allowance data.
OORC	Operating life cycle replacement costs for organizational/overhead officers/WOs less crew.
OPCSC	Officer/warrant officer PCS cost per man.
OPCSR	Officers/warrant officers annual PCS rate.
PACEM	Total annual pay and allowance for all crew enlisted men. To be obtained from TOE personnel pay and allowance data.
PADMEN	Total annual pay and allowance for all overhead/dedicated maintenance enlisted man. To be obtained from TOE personnel pay and allowance data.
PADO	Total annual pay and allowance for dedicated organizational/overhead officers/WOs less crew and maintenance officers. To be obtained from TOE personnel pay and allowance data.

PADOC	Total annual pay and allowance for all dedicated/overhead officers assigned to the crew. To be obtrained from TOE personnel pay and allowance data.
PADOEM	Total annual pay and allowance for all overhead/dedicated organizational enlisted man. To be obtained from TOE personnel pay and allowance data.
PADOM	Total annual pay and allowance for all dedicated/overhead maintenance officers/WOs. To be obtained from TOE personnel pay and allowance data.
PCS	Operating life cycle permanent change of station cost.
PCSE	Operating life cycle permanent change of station cost for enlisted men.
PCSO	Operating life cycle permanent change of station cost for officers/WOs.
QEPD(5)	Number of enlisted personnel (including overhead, dedicated plus crew) in the TOE organization under evaluation excluding enlisted maintenance personnel.
QEPM(6)	Number of field level enlisted maintenance personnel as determined by LOGAM logistics support calculations for number of test and repair men.
QLIN	Quality of a specific TOE line item (LIN) that uses POL as determined by the TOE equipment allowance.
QO(7)	Number of officers/warrant officers in the TOE organization under evaluation.
RCO	Operating life cycle personnel replacement cost for officers/WOs.
RFU	Rate of fuel usage per operating hour, gal per hour.

(5) All overhead, dedicated and crew enlisted personnel from data based TOE organization.

(6) QPEM = PERS (1,1) + PERS (2,1) + PERS (2,2) + PERS (3,1) + PERS (3,2).

(7) Obtained from sort of all officers/warrant officers from data based on TOE organization.

TNEM	Total number of dedicated/overhead enlisted man excluding maintenance in the organization under evaluation. To be obtained from TOE personnel allowance data.
TPPFE	Transients, patients, prisoners factor for enlisted men.
TPPFO	Transients, patients, prisoners factor for officers.
YR	Number of years in O and S phase.

SECTION 6

SENSITIVITY TESTING

When a tray of cards punched with a set of input data has been run as a baseline case, it is often desirable to be able to rerun the entire tray with selected changes in certain of the input variables. To facilitate this, the program writes a copy of the input data to a memory device during the baseline run. Subsequently, these data may be retrieved, edited, and rerun. These reruns of the input tray based on selected editing are referred to as sensitivity runs.

6.1 Sensitivity Input Array

One of the elements of the input NAMELIST/L/ is an array named SENSY. Values input to this array are used to direct the conduct of sensitivity runs. The array SENSY, stored in common block SENS, has Dimension 266. Entries into these 266 storage locations perform the following functions:

a) Specify the number of input variables whose values are to be edited during the sensitivity runs.

b) Specify the number of times the inputs are to have their values edited. (This specifies the number of sensitivity runs).

c) Specify the rules to be used for the editing of each designated input.

d) Designate the inputs to be altered.

e) Furnish the numeric values to be used by the specified rules in the edition of the designated inputs.

6.1.1 First Element of the SENSY Array. The first element of SENSY, i.e., SENSY(1), is used to accomplish Function (a) in Section 4.1. A positive, real, whole number is entered to state the number of inputs being tested. Within the program, this is called MODE. This program is currently written so that MODE may range from one to twelve inputs. More than twelve inputs results in an error message:

BAD SENSY

followed by a printout of the contents of array SENSY, the sensitivity test is abandoned, and the program resumes as though it were a new start after completing sensitivity testing.

The exact value 0 is used to denote that sensitivity testing is off and the program is running baseline cases. This value exists at program start by initialization in a BLOCK DATA subprogram. Thus, SENSY need not be input to run the baseline case. Only after the completion of all the work of a sensitivity run, SENSY(1), all elements of SENSY are reset to zero and no input is needed to resume analysis of baseline cases.

Negative values in SENSY(1) will run SENSY with unpredictable results. Negative values should not be entered for SENSY(1).

6.1.2 Second Element of the SENSY Array. The second element of SENSY, i.e., SENSY(2), is used to carry out Function (b) given in Section 6.1. A positive, real, whole number is entered to stipulate the number of sensitivity runs. This is known as NPASS within the program. Due to the limitations of the dimensionality of SENSY, there is a limit to the number of passes that can be made by one loading of SENSY. The number depends on MODE. Table 13 lists the limits on NPASS for the twelve possible values of MODE.

Table 13. LIMITS ON SENSY(2)

MODE	NPASS LIMIT
1	262
2	130
3	86
4	64
5	50
6	42
7	35
8	31
9	27
10	24
11	22
12	20

The remaining elements of SENSY are furnished as ordered sets of size MODE. Thus, if only one input is being tested, the set size is one; if two, the size is two, etc. up to the limit of twelve per set when MODE is 12.

6.1.3 Third Element of the SENSY Array. Function (c) in Section 6.1 is the specification of the edited rules. This is accomplished by furnishing a set of positive, real, whole numbers. There is one rule number in the set for each of the MODE variables to be varied. The permissible rule number and effects are the following:

Rule Number	Effect
1.	Assign
2.	Add
3.	Subtract
4.	Multiply
5.	Divide

If any other value is used, an error message will be written as follows:

ILLEGAL RULE KRULE = X

giving the sequence of the rule. That input will not be altered and the program will continue. Later sets of entries in SENSY contain values to

be used with these rules. Thus, for Rule 1, the value furnished is used instead of the value in the baseline data. Rules 2, 3, 4, and 5 take the value given in SENSY and combine it with the baseline value to obtain a new value using addition, subtraction, multiplication, or division as specified.

Within the program, the set of rules is stored in array NRULE, of Dimension 12. Should Rule 5 ever encounter the value zero in SENSY, the error message

ATTEMPTED DIVIDE ERROR INDEX = X

will be written where X will be the sequence number in the SENSY array. The program will continue using the baseline value for that variable.

Thus, with MODE in SENSY(1), NPASS in SENSY(2), the set of MODE rules are entered in sensy(3) to SENSY (MODE + 2).

6.1.4 Designation of the Variables to be Tested. In the designation of the variables for sensitivity testing, the program is structured to reference them by their numbered positional location in common block INPUT rather than by name. The numbered sequence for addressing LOGAM inputs to be sensitivity tested is given in Table 14. The listing shown is alphabetically and numerically sequenced for LOGAM except for three inputs at the end. Thus, to refer to input E, the LRU failure rate, the number to be entered in SENSY is 81. The reference numbers are to be entered as positive real whole numbers. Should a value other than those in the table be entered an error message will be entered as follows:

ILLEGAL VARIABLE ADDRESSED = M

where M is the illegal number. The program will continue and no variable wil be altered for that bad vlue.

Thus, to carry out Function (d) in Section 6.1, an altered set of MODE variable numbers is entered into SENSY (2 + MODE + 1) through SENSY (2 + MODE + MODE). These are stored in the program array NVAR, of Dimension 12.

6.1.5 Designation of the New Values for the Inputs. The remaining portion of SENSY is used to enter NPASS sets of MODE elements to carry out Function (e) in Section 6.1, i.e., supply the values to be used to alter each variable designated, according to the rule, for each pass. Thus, to recapitulate:

SENSY(1)	MODE	Number of inputs to be tested
SENSY(2)	NPASS	Number of Runs or Passes

Table 14. SEQUENTIAL LISTING OF INPUTS BY SENSY
(Giving FORTRAN Name of Input and Corresponding
SENSY Designation Number)

ARA	1	CPI	52	FN	103	SUE	154	WD	205	TAYZ(7)	256
AYZP	2	CPII	53	FNGF	104	SUI	155	WI	206	TAYZ(8)	257
CAD	3	CPP	54	FSA	105	SUO	156	WDR	207	TAYZ(9)	258
CALMAN	4	CPUBII	55	FSA	106	SVE	157	WE	208	TAYZ(10)	259
CALPUB	5	CRI	56	FTI	107	SVR	158	WEM	209	ZM(1)	260
CALSET	6	CRII	57	FTII	108	SVT	159	WER	210	ZM(2)	261
CCAL	7	CRM	58	FTM	109	SVV	160	WI	211	ZM(3)	262
CCALP	8	CRP	59	FTP	110	TALMAN	161	WIM	212	ZM(4)	263
CCALR	9	CRU	60	FTU	111	TATE	162	WIR	213	ZP(1)	264
CCSP	10	CSDEP	61	FUD	112	TC	163	WM	214	ZP(2)	265
CCSPP	11	CSDSU	62	FUE	113	TD	164	WO	215	ZP(3)	266
CCSPR	12	CSESU	63	FUI	114	TDI	165	WOM	216	ZU(1)	267
CDDI	13	CSGSU	64	FUO	115	TDMAN	166	WOR	217	ZU(2)	268
CDEO	14	CTCPUB	65	HPM	116	TDMW	167	WP	218	ZU(3)	269
CDFD	15	CTRA	66	HPP	117	TDPMI	168	WTKIT	219	ZU(4)	270
CDID	16	CTRCAL	67	HPU	118	TDPMII	169	WU	220	STAT	271
CDIO	17	CTRI	68	OD	119	TDPRI	170	YAT	221	DTE	272
CDIST	18	CTRII	69	ODS	120	TDPRII	171	YD	222	DTO	273
CDMAN	19	CTRSPT	70	PTF	121	TDR	172	YMWO	223	DTI	274
CDOE	20	CUBEM	71	P	122	TDRMAN	173	YP	224	REO	320
CDOI	21	CUBEP	72	PMR	123	TE	174	YR	225	ARAD	321
CDPMAN	22	CUBEU	73	PP	124	TER	175	YZ	226	CTRAD	322
CDPRMN	23	CUCE	74	PRP	125	TEMAN	176	ZFL	227	TENMAN	325
CDRMAN	24	CUP	75	PUR	126	TERMAN	177	ZI	228		
CEMAN	25	DAOQL	76	MM	127	TEO	178	ZO	229		
CEN	26	DD	77	QMP	128	TF	179	H(1)	230		
CEND	27	DDS	78	QMU	129	TFR	180	H(2)	231		
CERMAN	28	DI	79	QTD	130	TGMAN	181	H(3)	232		
CFTD	29	DIS	80	QTE	131	TGRMAN	182	H(4)	233		
CGMAN	30	E	81	QTI	132	TI	183	OL(1)	234		
CGRMAN	31	ED	82	QTMD	133	TID	184	OL(2)	235		
CI	32	EDS	83	QTME	134	TIMW	185	OL(3)	236		
CII	33	EE	84	QTMI	135	TIO	186	OL(4)	237		
CKIT	34	EVDM	85	QTMO	136	TIR	187	OST(1)	238		
CKMD	35	EVDR	86	QTO	137	TMD	188	OST(2)	239		
CKME	36	EVDT	87	QTPD	138	TMDO	189	OST(3)	240		
CKMI	37	EVEM	88	QTPI	139	TMDR	190	OST(4)	241		
CKMO	38	EVER	89	QTPO	140	TMI	191	SL(1)	242		
CKPD	39	EVET	90	RDD	141	TMID	192	SL(2)	243		
CKPI	40	EVIM	91	REPEAT	142	TMIR	193	SL(3)	244		
CKPO	41	EVIR	92	RID	143	TMO	194	SL(4)	245		
CKUD	42	EVIT	93	ROI	144	TMOD	195	TAT(1)	246		
CKUE	43	EVOM	94	SMD	145	TMOR	196	TAT(2)	247		
CKUI	44	EVOR	95	SME	146	TOE	197	TAT(3)	248		
CKUO	45	EVOT	96	SMF	147	TOI	198	TAT(4)	249		
CLRUPG	46	FI	97	SMI	148	TOMW	199	TAYZ(1)	250		
CMODPG	47	FIT	98	SMO	149	TONMAN	200	TAYZ(2)	251		
CMP	48	FINT	99	SPE	150	TRC	201	TAYZ(3)	252		
CONMAN	49	FMD	100	SPEV	151	TUMD	202	TAYZ(4)	253		
CONTCT	50	FMI	101	SPEVR	152	TUMI	203	TAYZ(5)	254		
CPE	51	FMO	102	SUD	153	TUMO	204	TAYZ(6)	255		

SENSY(3) to MODE + 2	NRULE	Set of Rules for Editing
SENSY [(MODE + 3) to (MODE + MODE + 2)]	NVAR	Designation of Input Variables
SENSY [(MODE + MODE +3) to (MODE + MODE + MODE + 2)]		First Set of Values

and so forth.

6.2 Example of NAMELIST Inputs for Typical Sensitivity Run

If it is desired to investigate the simultaneous variation of failure rate and false no-go fraction, a typical set of values would be as follows:

MODE = 2.

To run three sets of data:

NPASS = 3.

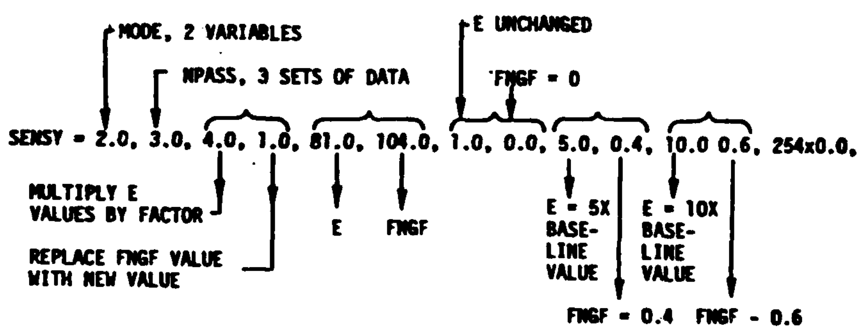
The input designators, from Table 14 are

E 81
FNGF 104

In the baseline run, if FNGF was 0.2 for all LRUs and it is desired to run 0., 0.4, and 0.6, for all LRUs, then Rule 1 is used and 0., 0.4, and 0.6 are assigned at the first, second, and third pass, respectively.

For the failure rate E, all LRUs have different values. Rule 1 is not useful as there is no desire to assign the same failure rate to each LRU. More commonly, it is desirable to run multiples of the baseline. Thus, Rule 4 is useful. If no change is desired for the first pass, then the value 1 is used. (This will show the effect of FNGF = 0, without changing E). If for second and third passes, simultaneously with the doubling and tripling of the false no-go fraction, it is desired to increase the failure rate by factors of 5 and 10, then values 5 and 10 are used.

Then, the input punched for input via NAMELIST/L/ will have the following appearance:



The program will run each pass specified by SENSY. (The baseline data store is "rewound" each time and at the end. The stored baseline data are NOT ALTERED). After the last pass, control returns to the program and execution continues looking for new input data. At this point, another SENSY may be entered and the same saved baseline data will be further sensitivity tested.

If another SENSY is not entered, then new baseline cases may be entered. In such a case, the old saved baseline data are destroyed and the new set is saved. At this point, a control may be entered to stop the program.

Program flow to effect sensitivity control is contained in the detailed LOGAM flow diagram shown previously in Section 3. Table 15 shows a worksheet that is convenient for use in preparing sensitivity input data.

6.3 Sensitivity Testing Specification

Included at the end of Appendix C is a sensitivity NAMELIST input data set that was run with the baseline USAREUR and CONUS data set. As shown, the input cards for sensitivity testing are placed after the final LRU data set. To use the sensitivity test feature of LOGAM, at least three cards must be punched. The first two are generally used as header cards to identify certain factors pertaining to the particular sensitivity run set. The third (and subsequent cards if required - the exact number depending on number of variables and passes to run) is the input array in the NAMELIST format as discussed in Section 6.2.

6.3.1 Sensitivity Output. Along with the SENSY array, the control INHIB may be used to suppress the individual LRU printout. If INHIB = 1 is used, the output page for the final LRU and the total page only will be printed. If the control INHIB is not activated, the output printout contains the same number of pages as the USAREUR and CONUS baseline results. These printouts, however, will show the results for the new values of the inputs as controlled by the rules contained in the SENSY NAMELIST array.

The printout of output on totals pages will always be preceded by a printout of the new values of the inputs identified by the designation number given in Table 14. Thus, the new value of the input/inputs assigned by activating the sensitivity test feature of LOGAM is always documented.

6.4 The Versatility Provided by the Built-in Sensitivity Test Feature

The suggested sensitivity parameters and examples shown in Section 7 indicate the versatility of LOGAM. The sensitivity test feature represents a powerful tool for the evaluation of logistic support alternatives. Almost any input variable or combination of inputs can be varied through any range of values during any computer run. The use of

Table 15. Sample of Sensitivity Work Sheet (Layout Array of SENSY)

SENSITIVITY WORK SHEET
(layout of array SENSY)

MODE = ________
NPASS = ________

NRULE
1 ASSIGN VALUE
2 ADD VALUE
3 SUBTRACT VALUE
4 MULTIPLY BY VALUE
5 DIVIDE BY VALUE

	VARIABLE NAME													NOTES
	(Sequence No.)	1	2	3	4	5	6	7	8	9	10	11	12	NOTES
	NRULE													
	NVAR													
VALUES	1st Set													
	2nd Set													
	3rd Set													
	4th Set													
	5th Set													
	6th Set													
	7th Set													
	8th Set													
	9th Set													
	10th Set													
	11th Set													
	12th Set													
	13th Set													
	14th Set													
	15th Set													
	16th Set													
	17th Set													
	18th Set													
	19th Set													
	20th Set													
													****	
	21st Set												****	
	22nd Set												****	
	23rd Set											****	****	
	24th Set											****	****	
	25th Set										****	****	****	
	26th Set										****	****	****	

**** Forbidden Combination

MODE: Number of variable tested
NPASS: Number of variations
NVAR: See table ______

the technique makes it possible to evaluate multiple effects on logistics cost and effectiveness very rapidly through the application of a carefully planned run set.

SECTION 7

PROGRAM OUTPUT AND RESULTS REPORTING

7.1 Program Output

LOGAM provides printouts of eight types:

a) LRU costs.
b) Supplemental LRU output for maintenance policies GC, GI, GJ, GK.
c) Case totals (could be subsystem totals).
d) System maintenance support cost.
e) Individual cost categories from LOGAM added to Pam Break-Out.
f) Individual LRU totals for two or more scenarios.
g) Grand totals.
h) System maintenance support cost.

Printouts (a) and (c) are also modified slightly when the sensitivity option is used. These two printouts then indicate the fact that sensitivity was employed by additionally printing the input variables selected with their respective input sensitivity values. This section explains the eight output printout types via examples and illustrates some ways the printed results data may be displayed graphically.

7.1.1 LRU Printout. The individual component or LRU printout is shown in Figures 10 and 11. Figure 10 is for an LRU where the service channel data is not tallied; Figure 11 shows the result when the appropriate tally flags are input as unity. (Appendix B glossary contains explanation of tally controls ETI, ETII.) The main difference between the two outputs is that Figure 10 includes test equipment and maintenance manpower cumulative information that has accrued since the last tally was taken. In this instance, a tally is taken for Type I test equipment by inputting ETI=1. with the other LRU input data. In addition to cost data, the printout shows quantities of units, modules, and parts. The module and part data are per module and part type. Test equipment and repair channel data show the fraction of real time that the service channel is utilized. EACH refers to the individual LRU while CUM refers to the cumulative utilization since the last tally was taken. Also shown in the upper right hand portion of the output pages are the operational and inherent availabilities for the individual LRU.

7.1.2 Supplemental LRU Printout. The supplemental LRU page (Figure 11A) is printed for each LRU when either policy GC, GI, GJ or GK is involved. The page follows immediately after the primary individual LRU output page. Its contents are discussed later in this section.

7.1.3 Cost Totals Output Printout. Figure 12 shows a sample LOGAM totals summary printout. The header information is the same as for the preceding individual LRU pages (Figure 11). The Grand Total Cost presented in the upper left portion of Figure 12 lists the top level

```
                    COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                     USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                      MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                        ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 2 LRU NO. 3                                                          ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS          DATE - JULY 1982


PRESENT VALUE COST TOTAL
EACH      CUM
    1361.    10815.     THOUSANDS OF DOLLARS                AVAILABILITY=  .999928  INHERENT=  .999928
PRIME     T.E.       TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
     0.        2.         0.       58.     1137.        3.        0.      158.        4.     1361.


PROVISION         INITIAL BUY         REORDER BUY        CONSUMED            RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
   24.    5.   2.  165.  170.  172.   20.    50.  100.    0.     0.   17.   24.     5.    0.


TEST EQUIPMENT AND REPAIR CHANNEL DATA
                DIRECT                                         GENERAL                                        DEPOT
    T.E.                                REPAIR      T.E.                             REPAIR      T.E.                               REPAIR
    EACH          CUM        EACH         CUM       EACH         CUM        EACH        CUM      EACH         CUM        EACH         CUM
   0.0000      0.0000      0.0000      0.0000      .0027       .0027       .0064      .0064     .0059       .0059       .0106       .0106
               0.0000                  0.0000                  .0146                  .0165                 .0406                   .0564


ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
          DIRECT                           GENERAL                           DEPOT
T.E.      TE MEN     REP MEN    T.E.      TE MEN     REP MEN    T.E.      TE MEN     REP MEN
   0.        0.         0.        2.         0.         0.        1.         0.         0.
0.0000                          .0030                           .0065
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
           DEPOT
T.E.      TE MEN     REP MEN
       0.        0.         0.
   0.0000


EXPECTED VALUE MANPOWER AT EQUIPMENT, DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
    1361.    10815.    MANPOWER       58.     DELTA          -0.     PV DELTA        -0.
INITIAL PROVISION QUANTITIES OF
                       UNITS                                           MODULES                                       PARTS
   EQPT.     DIRECT    GENERAL       DEPOT       DIRECT    GENERAL     DEPOT        DIRECT     GENERAL      DEPOT
     0.        18.        6.           0.           0.         4.         1.           0.          0.          2.
COST OF INITIAL PROVISION                                            RESIDUAL
          EQPT.       DIRECT      GENERAL       DEPOT       TOTAL
UNIT        0.         339.        113.           0.         452.        452.
MODULE                   0.         48.          12.          60.         60.
PART                     0.          0.           0.           0.          0.
```

Figure 10. Output Format For Individual LRU When Test Equipment and Manpower Tally Is Not Taken.

```
                         COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                          USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                           MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                              ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 2 LRU NO. 5                                                                ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS                DATE - JULY 1982


PRESENT VALUE COST TOTAL
EACH      CUM
    2851.     14480.     THOUSANDS OF DOLLARS             AVAILABILITY=  .999945  INHERENT=  .999947
PRIME     T.E.       TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE    S.ADMIN   SHIPPING  TOTAL
        0.      2400.       0.        45.      265.         2.         0.      136.        3.     2851.


PROVISION        INITIAL BUY        REORDER BUY        CONSUMED           RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
   15.     8.    2.  156.  164.  166.   20.    50.  100.    0.     0.   12.   15.     8.    0.


TEST EQUIPMENT AND REPAIR CHANNEL DATA
                 DIRECT                                          GENERAL                                      DEPOT
     T.E.                               REPAIR      T.E.                             REPAIR      T.E.                             REPAIR
     EACH        CUM        EACH         CUM        EACH       CUM        EACH         CUM       EACH        CUM        EACH         CUM
    0.0000     0.0000     0.0000      0.0000       .0035      .0035      .0056       .0056      .0033       .0033      .0060       .0060
               0.0000                 0.0000                  .0216                  .0289                  .0490                   .0709


ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
            DIRECT                                 GENERAL                                   DEPOT
T.E.       TE MEN     REP MEN     T.E.        TE MEN     REP MEN    T.E.       TE MEN     REP MEN
   0.         0.         0.          2.          0.         0.         1.         0.         0.
0.0000                            .0039                              .0037
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
             DEPOT
T.E.       TE MEN     REP MEN
       0.         0.         0.
    0.0000


EXPECTED VALUE MANPOWER AT EQUIPMENT, DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
    2851.     14480.     MANPOWER        45.     DELTA            0.     PV DELTA        0.
INITIAL PROVISION QUANTITIES OF
                       UNITS                                                        MODULES                                       PARTS
  EQPT.       DIRECT     GENERAL        DEPOT          DIRECT       GENERAL     DEPOT          DIRECT      GENERAL        DEPOT
    0.           9.          6.           0.              0.            6.          2.             0.           0.             2.
COST OF INITIAL PROVISION                                                       RESIDUAL
        EQPT.         DIRECT        GENERAL         DEPOT         TOTAL
UNIT         0.           45.           30.            0.           75.          75.
MODULE                     0.           24.            8.           32.          32.
PART                       0.            0.            0.            0.           0.
```

Figure 11. Output Format for Individual LRU when Test Equipment and Manpower Tally is Taken.

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 2 LRU NO. 1
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS

ANALYSIS - THREE LRU CLASSES
DATE - JULY 1982

SUPPLEMENTARY INFORMATION REGARDING POLICIES GC, GI, GJ GK/

TEST EQUIPMENT AND REPAIR CHANNEL DATA
FOR EQUIPMENT LOCATED FACILITIES

T.E.			REPAIR
EACH	CUM	EACH	CUM
.0001	.0001	.0001	.0001
	.0002		.0002

ROUNDED UP TOTALS FOR TYPE I TEST EQUIPMENT CHANNELS AT EQUIPMENT LOCATION

T.E.	TE MEN	REP MEN
141.	0.	0.
.0001		

INITIAL PROVISION QUANTITIES OF MODULES AT EQUIPMENT - 141.
COST OF INITIAL PROVISION MODULES AT THE EQUIPMENT - 4399.

Figure 11A. Supplemental Output Page for Information Related to Policies GC, GI, GJ or GK.

```
          COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
           USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
            MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
              ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES                                                     DATE - JULY 1982
                                              CASE TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                       RECURRING COSTS
     INSTALLED EQUIPMENT                 0.
     TEST EQUIPMENT                   5555.                               T.E. MAINTENANCE      322.
     TEST EQUIPMENT SPACE                0.                         DEPOT SPACE/UTILITIES        0.
     MAINTENANCE MANPOWER              610.          FIELD      291.  DEPOT       288. TOTAL    579.
                                            TRAINING FIELD       17.  DEPOT         0. TOTAL     17.
     SUPPLY MATERIAL                 16900.                                       SUPPLIES     7005.
     REORDERING                         24.                                     REORDERING       24.
     MATERIAL STORAGE                    0.                               MATERIAL STORAGE        0.
     SUPPLY ADMINISTRATION            1424.                           INVENTORY MANAGEMENT     1142.
     SHIPPING AND HANDLING              37.                                       SHIPPING       37.

     GRAND TOTAL COST                24550.                                TOTAL RECURRING     9126.


     PRESENT VALUE                                                   COST OF INITIAL PROVISION
     DEVELOPMENT                      3619.                                          UNITS     3850.
     ACQUISITION                     11791.                                        MODULES     6041.
     OPERATION AND MAINTENANCE        9140.                                          PARTS        4.
     END LIFE SALVAGE                    0.                                TOTAL PROVISION     9895.

     GRAND TOTAL                     24550.

EXPECTED VALUE MANPOWER AT EQUIPMENT DIRECT AND GENERAL

     MAINTENANCE MANPOWER              610.
     GRAND TOTAL COST                24550.
     PRESENT VALUE
     OPERATION AND MAINTENANCE        9140.
     GRAND TOTAL                     24550.       DELTA        -0.        PV DELTA       -0.
```

Figure 12. Output Format for Cost-Totals Summary

cost items in the Grand Total Cost summation. These items have been formulated in four distinct time phases:

a) Development.
b) Acquisition.
c) Operation and Maintenance.
d) End of Program Salvage.

The equations used in each time phase calculation and the Grand Total cumulation follow:

a) Development:

CD = CED + CTSD + CTSOFT

where CED is prime equipment, CTSD test equipment, and CTSOFT is the cost of technical data or programming.

b) Acquisition:

CP = CEP + CTSP + CIVP + CSAP + CMPPY

where CEP is prime equipment, CTSP is test equipment, CIVP is initial material allowance, CSAP is entry of items for supply administration, and CMPPY is nonrecurring training costs.

c) Operation and Maintenance:

CR = CTSR + CFR + CMPR + CMPRR + CIVR + CROR + CWHR + CSAR + CSHR + CSVR

where CTSR is test equipment support, CFR is test equipment space at Depot, CMPR is maintenance manpower, CMPRR is repair manpower, CIVR is material consumption, CROR is reordering, CWHR is material storage, CSAR is ongoing supply administration, CSHR is shipping and handling, and CSVR is salvage on consumed material.

d) End or Program Salvage:

CS = CEV + CTSV + CIVV

where CEV is salvage on installed equipments, CTSV is salvage on test equipment, and CIVV is salvage on residual inventory.

The Grand Total Cost is computed as GCT = CD + CP + CR + CS the sum of the four time phased costs.

Following the heading on Figure 12, costs are broken down in four different ways:

a) Grand total cost elements.
b) Recurring (O&M) cost elements.
c) Initial provisioning cost elements.
d) Present value cost elements.

First on the left side of the Figure 12, the following breakdown is given:

a) Installed Equipment: The cost to develop and procure the fielded prime equipment less salvage (this cost was not included in the run on which Figure 12 is based.

b) Test Equipment: The sum of the costs for test equipment development, test equipment procurement, test equipment maintenance, and test programs or documentation less salvage.

c) Test Equipment Space: The charges for the space and utilities required by the test equipment.

d) Maintenance Manpower: The cost for all maintenance manpower for Field and Depot test and repair including their training and other special manpower costs for calibration and field contact teams at the equipment level, if applicable.

e) Supply Material: The cost of initial provisioning of units, modules, and parts plus the cost for supplies consumed during the O&M phase less salvage value of residual inventory.

f) Reordering: The administrative costs for reordering units, modules, and parts throughout the life of the program.

g) Material Storage: The sum of all charges for storage of units, modules, and parts at the organizational, intermediate, or depot levels, if applicable.

h) Supply Administration: The sum of the costs to enter and keep all unique items in the inventory.

i) Shipping and Handling: The cost for shipping units, modules, and parts throughout the life of the program.

j) Grand Total Cost: The sum of all of the cost elements given previously.

The entry RECURRING COSTS at the upper right-hand portion of Figure 12 gives a breakdown of all recurring costs for operations after the equipment is fielded including the following:

a) Test equipment maintenance.
b) Test equipment space/utilization charges.
c) Manpower for operating test equipment plus repair manpower.
d) Recurring training costs.
e) Costs of consumed supplies.
f) Reorder costs.
g) Storage costs.
h) Inventory management.
i) Shipping Costs

The entry COST OF INITIAL PROVISION lists the pipeline costs for units, modules and parts. It also gives the sum of these costs.

The second entry on the left-hand side of Figure 13, under the heading PRESENT VALUE, can be used to show present values costs assuming some yearly discount rate, if desired (definition for FINT in Appendix B). Present value costs are broken down as follows:

a) Development: The sum of prime equipment development, test equipment including equipment for fault isolation, calibration, and field test at the equipment level plus software or other documentation costs.

b) Acquisition: The sum of the costs for procurement of prime equipment, initial provision of units, modules, and parts, the nonrecurring training costs plus the cost to enter items in the inventory.

c) Operation and Maintenance: The sum of the costs of "operation and maintenance" of the entry previously listed. This value, however, can be discounted.

d) End Life Salvage: Salvage credits taken for prime equipment, test equipment, and inventory items can be shown here.

e) Grand Total: This number is the same as the previous Grand Total entry, unless the discounting feature is activated by inputting FINT $\neq$ 0.

LOGAM has the option to use dedicated or expected value (shared) test and repair manpower (definitions for expected value flags for manpower EVEM, EVOM, EVIM, EVDM, EVER, EVOR, EVIR, and EVDR in Appendix B). If dedicated manpower is selected, the program also computes the expected value costs for all field manpower. The results of this computation are printed out under the heading EXPECTED VALUE MANPOWER AT DIRECT AND GENERAL in the lower portion of Figure 13. The program also computes the cost differential (depending on what was input for the expected value flags) between dedicating the manpower and sharing the manpower and produces the output called DELTA. The object of the DELTA computation is to display the cost penalty of dedicated manpower in the field as opposed to shared manpower in the field.

The availability products are also shown for all the LRUs that are considered to operate as functional systems. Both the operational CAYZ and inherent CAYZI availability products are printed out.

Finally, the program computes and prints out the test equipment and repair channel utilization data. These results are for all equipment, DS, GS, and Depot locations. They summarize the test and repair channel utilization in hours per day and the number of men required to perform the maintenance functions.

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                    COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                     USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                      MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                         ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 3 LRU NO. 2                                                         ANALYSIS - THREE LRU CLASSES
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS         DATE - JULY 1982


PRESENT VALUE COST TOTAL
EACH      CUM
    8366.    24550.    THOUSANDS OF DOLLARS              AVAILABILITY=  .999914  INHERENT=  .999915
PRIME     T.E.      TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE   S.ADMIN   SHIPPING  TOTAL
       0.     3138.        0.      148.     4876.         3.        0.      185.       15.     8366.


PROVISION         INITIAL BUY        REORDER BUY         CONSUMED           RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
   29.     4.    2.  170.  174.  176.   20.    50.  100.    0.     0.   20.   29.     4.    0.


TEST EQUIPMENT AND REPAIR CHANNEL DATA
                 DIRECT                                          GENERAL                                DEPOT
     T.E.                               REPAIR     T.E.                               REPAIR     T.E.                               REPAIR
     EACH        CUM        EACH        CUM        EACH        CUM        EACH        CUM        EACH        CUM        EACH        CUM
   0.0000     0.0000      0.0000      0.0000       .0097       .0097      .0273       .0273      .0118       .0118      .0461       .0461
              0.0000                  0.0000                   .0366                  .0674                  .0654                  .1265


ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
           DIRECT                              GENERAL                              DEPOT
T.E.       TE MEN    REP MEN   T.E.       TE MEN    REP MEN   T.E.       TE MEN    REP MEN
   0.         0.         0.         1.         0.         0.         1.         0.         0.
0.0000                        .0107                           .0129
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
           DEPOT
T.E.       TE MEN    REP MEN
       0.         0.         0.
   0.0000


EXPECTED VALUE MANPOWER AT EQUIPMENT, DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH      CUM
    8366.    24550.    MANPOWER      148.     DELTA          -0.     PV DELTA      -0.
INITIAL PROVISION QUANTITIES OF
                       UNITS                                               MODULES                                     PARTS
  EQPT.       DIRECT     GENERAL       DEPOT         DIRECT      GENERAL      DEPOT          DIRECT      GENERAL        DEPOT
     0.          18.         11.          0.             0.           3.         1.              0.           0.           2.
COST OF INITIAL PROVISION                                                   RESIDUAL
         EQPT.        DIRECT       GENERAL        DEPOT        TOTAL
UNIT        0.         1355.          828.           0.         2183.        2183.
MODULE                    0.           98.          33.          130.         130.
PART                      0.            0.           0.            0.           0.
```

Figure 13. Individual LRU Summary Totals Printout

7.1.4 System Maintenance Support Cost Printout. Figure 14 prints the results of LOGAM in the format of the Army Life Cycle Cost Matrix as printed in DA Pamphlet 11-4. All categories are self-explanatory with exception of element 2:11 (Other) which is test equipment acquisition costs.

7.1.5 Individual Cost Categories from LOGAM added to Pam Break-Out. In Figure 15 the first line is operational Availability (CAYZ). The second line is Inherent Availability (CAYZI). For both lines the first value is the system availability, the second value is the first subsystem availability, the third value is the second subsystem availability and etc. up to ten values. The other printouts on this page are self explanatory.

7.1.6 Summary LRU Cost Totals. LOGAM also provides the versatility to sum up and print out the LCC for two or more theaters of operation on an individual LRU basis (discussion of header cards in Section 4.3). Figure 13 shows the format for a summary LRU cost TOTAL printout.

7.1.7 GRAND TOTAL Printout. The LOGAM program also prints out a GRAND TOTALS printout when called for which is essentially in the same format as Figure 12. This GRAND TOTALS is activated when the control NU = -3 is input and serves the purpose to summarize the summation of the LCC for two or more deployments or theaters of operation. After the GRAND TOTALS printout page the program prints the System Maintenance Support Cost (Figure 16) in the format of the Army Life Cycle Cost Matrix as printed in the DA Pamphlet 11-4. This matrix lists all costs computed by LOGAM including Operation and Support (O&S) Costs based on the TOE structure. The Matrix is then completed.

7.2 Reporting the Results

The application of the LOGAM computer model facilitates evaluation of the impact of logistics in terms of cost and effectiveness for different support postures for fielded military equipment. Costs may be based on current fiscal year dollars or may be discounted assuming a yearly interest rate. Costs already expended can be sunk.

7.2.1 Baseline Support Cost Comparisons. Many times, alternate support approaches are analyzed versus a baseline or existing maintenance support approach. Many ways can be used to explain and display the results of these analyses. The commonly used methods (and easiest) are the data table and bar graph or histogram methods. Table 16 illustrates the data table approach for a USAREUR deployment where the cost elements have been broken down to two cases by the following:

a) Ten-year operations.
b) Initial provision investment.
c) Test equipment acquisition.
d) Test equipment development.

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

SYSTEM OPERATIONS AND SUPPORT COSTS

		COST	PERCENTAGE
1.000	RESEARCH AND DEVELOPMENT		
1.010	DEVELOPMENT ENGINEERING	3619.00	100.00
TOTAL		3619.00	100.00
2.000	INVESTMENT COST		
2.010	NON-RECURRING INVESTMENT	0.00	0.00
2.050	DATA	0.00	0.00
2.080	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
2.090	INITIAL SPARES AND REPAIR PARTS	20345.25	88.01
2.11	OTHER	2772.00	11.99
TOTAL		23117.25	100.00
3.000	OPERATING AND SUPPORT COST		
3.010	MILITARY PERSONNEL		
3.011	CREW PAY AND ALLOWANCES	67520.71	44.65
3.012	MAINTENANCE PAY AND ALLOWANCES	1019.31	.67
3.013	INDIRECT PAY AND ALLOWANCES	14831.13	9.81
3.014	PERMANENT CHANGE OF STATION	13492.13	8.92
3.020	CONSUMPTION		
3.021	REPLENISHMENT SPARES	533.00	.35
3.022	PETROLEUM, OIL AND LUBRICANTS	3.70	.00
3.023	UNIT TRAINING AMMUNITION AND MISSILE	6993.60	4.63
3.030	DEPOT MAINTENANCE		
3.031	LABOR	1207.35	.80
3.032	MATERIEL	245.77	.16
3.033	TRANSPORTATION	4.18	.00
3.040	MODIFICATIONS MATERIAL	10603.77	7.01
3.050	OTHER DIRECT SUPPORT OPERATIONS		
3.051	MAINTENANCE, CIVILIAN LABOR	0.00	0.00
3.052	OTHER DIRECT	4585.67	3.03
3.060	INDIRECT SUPPORT OPERATIONS		
3.061	PERSONNEL REPLACEMENT	26110.63	17.27
3.062	TRANSIENTS, PATIENTS AND PRISONERS	2632.01	1.74
3.063	QUARTERS, MAINTENANCE AND UTILITIES	577.08	.38
3.064	MEDICAL SUPPORT	0.00	0.00
3.065	OTHER INDIRECT	849.18	.56
TOTAL		151209.22	100.00
GRAND TOTAL		177945.47	

Figure 14. System Operations and Support Costs

```
                                              $$$$$IMPORTANT$$$$$
THE FOLLOWING SEVEN CHECK NUMBERS MUST BE ZERO FOR THE PAM COST EQS. FROM LOCAM TO BE CORRECT.
CHECK EQS SHOULD BE ZERO IF PAM EQS ARE OK
 -.45474735E-12  0.              0.              -.14551915E-10  0.              -.18189894E-11  -.14551915E-10

                                    $$$$$$$$$$THE TOTAL LOCAM COST MUNUS PAM COST EQUALS      -.40745363E-09   $$$$$$$$$$

INDIVIDUAL COST CATEGORIES FROM LOCAM ADDED TO PAM BREAK-OUT
   .36190000E+04  0.              0.              0.              .98948170E+04   .29049582E+03   .24090523E+03   .30836176E+03
   .91602204E+02   .20532000E-01   .69725960E+04  0.              .32690117E+02   .36709020E+02   .14486598E+04  0.
 CAYZ=  .998757  .999790  .999290  .999677
CAYZI=  .999330  .999921  .999560  .999849
                          MAN-E          EQUIP          DIRECT         GENERAL          DEPOT
HRS PER YR ALL MAINT LOC
   TEST EQUIPMENT        89.523        245.807          0.000         352.667         630.163
   REPAIR               746.029        223.461          0.000         591.017        1109.069
NO OF MEN PER ANY TIME
UNIT ALL MAINT LOC
   TEST EQUIPMENT          .036           .056          0.000            .338            .604
   REPAIR                  .298           .051          0.000            .566           1.063
HRS PER YR PER MAINT LOC
   TEST EQUIPMENT          .635          1.743          0.000         352.667         630.163
   REPAIR                 5.291          1.585          0.000         591.017        1109.069
NO OF MEN PER ANY TIME
UNIT PER MAINT LOC
   TEST EQUIPMENT          .000           .000          0.000            .338            .604
   REPAIR                  .002           .000          0.000            .566           1.063
AT CHECK   12  0.           0.             0.              0.              0.              -.56843419E-13  0.
```

Figure 15. The Total LOGAM Cost Minus PAM Cost

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

SYSTEM MAINTENANCE SUPPORT COSTS

		COST	PERCENTAGE
1.000	RESEARCH AND DEVELOPMENT		
1.010	DEVELOPMENT ENGINEERING	3619.00	100.00
TOTAL		3619.00	100.00
2.000	INVESTMENT COST		
2.010	NON-RECURRING INVESTMENT	0.00	0.00
2.050	DATA	0.00	0.00
2.080	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
2.090	INITIAL SPARES AND REPAIR PARTS	13038.80	82.47
2.11	OTHER	2772.00	17.53
TOTAL		15810.80	100.00
3.000	OPERATING AND SUPPORT COST		
3.010	MILITARY PERSONNEL		
3.011	CREW PAY AND ALLOWANCES	0.00	0.00
3.012	MAINTENANCE PAY AND ALLOWANCES	366.78	2.83
3.013	INDIRECT PAY AND ALLOWANCES	0.00	0.00
3.014	PERMANENT CHANGE OF STATION	0.00	0.00
3.020	CONSUMPTION		
3.021	REPLENISHMENT SPARES	530.91	4.09
3.022	PETROLEUM, OIL AND LUBRICANTS	0.00	0.00
3.023	UNIT TRAINING AMMUNITION AND MISSILE	0.00	0.00
3.030	DEPOT MAINTENANCE		
3.031	LABOR	495.22	3.82
3.032	MATERIEL	160.16	1.23
3.033	TRANSPORTATION	3.34	.03
3.040	MODIFICATIONS MATERIAL	9289.05	71.61
3.050	OTHER DIRECT SUPPORT OPERATIONS		
3.051	MAINTENANCE, CIVILIAN LABOR	0.00	0.00
3.052	OTHER DIRECT	2040.14	15.73
3.060	INDIRECT SUPPORT OPERATIONS		
3.061	PERSONNEL REPLACEMENT	43.86	.34
3.062	TRANSIENTS, PATIENTS AND PRISONERS	0.00	0.00
3.063	QUARTERS, MAINTENANCE AND UTILITIES	0.00	0.00
3.064	MEDICAL SUPPORT	0.00	0.00
3.065	OTHER INDIRECT	42.62	.33
TOTAL		12972.07	100.00
GRAND TOTAL		32401.87	

Figure 16. System Maintenance Support Costs

Table 16. Example of Data Table Reporting ($ in Thousands)

			CASE I	CASE II
(A) 10 YEAR OPERATING COSTS	MAINTENANCE MANPOWER	FIELD	352	–
		DEPOT	329	1,202
	TEST EQUIPMENT MAINTENANCE		340	251
	SUPPLY MATERIAL		8,267	9,412
	INVENTORY MANAGEMENT		1,188	1,188
	ORDER, STORE, SHIP, AND HANDLE		138	324
	SUBTOTAL		10,614	12,377
(B) INITIAL PROVISION INVESTMENT	LINE REPLACEABLE UNITS		6,272	11,866
	MODULES/PARTS		642	253
	COST TO ENTER		294	294
	SUBTOTAL		7,208	12,413
(C) TEST EQUIPMENT ACQUISITION	INTEGRATED DIRECT SUPPORT MAINTENANCE (IDSM) TEST SETS		1,000	1,000
	DIRECT SUPPORT (DS) TEST SETS		263	–
	GENERAL SUPPORT (GS) TEST SETS		220	–
	DEPOT TEST STATIONS		264	220
	SUBTOTAL		1,747	1,220
(D) TEST EQUIPMENT DEVELOPMENT	IDSM TEST SETS		425	425
	DS TEST SETS		1,824	–
	DEPOT/GS TEST STATIONS		1,370	3,285
	SUBTOTAL		3,619	3,710
TOTAL SUPPORT COSTS			23,188	29,720

The data shown can be used to substantiate logistics support decisions, because they clearly indicate the lowest cost support alternative and show a breakdown of the significant elements contributing to support costs.

Another way of presenting the same information is the use of the bar graph as shown in Figure 17 to provide a pictorial presentation. The operational availability can also be included in this presentation as shown to provide a comparison on the basis of cost and effectiveness. The bar graph also gives visibility of the cost elements designated as segments A, B, C, and D. Segment A represents a summary breakdown of the ten-year operating cost elements. Segments B, C, and D summarize the elements which comprise nonrecurring costs.

7.2.2 <u>Test Equipment Utilization and Manpower Reporting</u>. The LOGAM model computes the service channel utilization for each item requiring checkout and repair as a fraction of real time. As an option in the program, manpower requirements adjusted for suitable productivity factors can be accounted for on an expected value basis. For manpower computations, reporting can encompass:

a) Manpower productivity.
b) Slack time (waiting for repair items, test accessories, etc.)
c) Test station availability and other contingency operations.

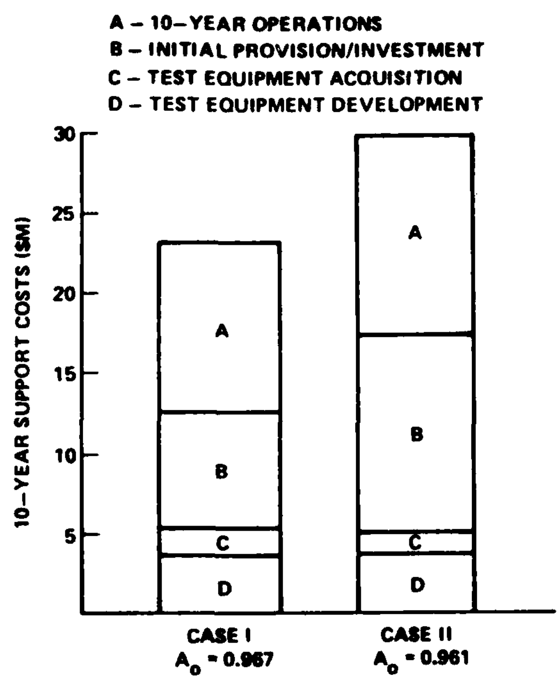

Figure 17. Example of Bar Graph Reporting

Table 17 is an example of test equipment utilization and manpower reporting in the data table format. The service channel utilization is given in terms of the cumulative hours per day spent at the various test and repair locations. The number of manpower site and total manpower for all sites is also indicated for each of the support alternatives studied.

7.2.3 Sensitivity Results Reporting. LOGAM has a built-in variation of parameters capability called sensitivity (Section 6) which is particularly useful in the rapid evaluation of tradeoffs where few "hard" data are available or where the analyst has low confidence in his data.

The results obtained from sensitivity testing may be used to construct graphs which display the behavior of the maintenance concept over the range of input parameters. Such graphs provide insight into the problems being investigated and help the analyst to determine which input parameters are critical to his application. That is, sensitivity may show that wide variation of some of the input parameters, among them perhaps his low confidence data, makes little or no difference in his result. Sensitivity will also help him to know which of his input parameters are very important and therefore need further investigation to refine or substantiate his input values.

The factors which influence workload such as maintenance incident rate, the number of deployed systems or prime equipment utilization are generally prime candidates for investigations of support cost sensitivity. Other investigations might include the effect of increasing or decreasing the modification workload, present value theory effect, or the generation of data to make comparisons of the basis of equal effectiveness (availability).

7.2.3.1 Examples of the Influence of Workload on Support Costs. Figure 17 was prepared from the results obtained for sensitivity test runs that were made along with the baseline USAREUR and CONUS runs.* At the baseline reference point (maintenance incident rate multiple = 1), the support costs are shown as the total support costs for Cases I and II. The results shown in Figure 18 indicate the support cost trends as the maintenance incident rate increases or decreases about the baseline value.

Another way of viewing the same result is to plot support costs versus the inverse of maintenance incident rate. This was done to obtain the results shown in Figure 19 which plots the support costs versus MTMBA. In Figure 19, there are curves which display the characteristic "knee" as time between maintenance increases. Sensitivity testing can also be used to investigate the effect of simultaneous variations of more than one input variable. This feature was used to obtain the result presented in Figure 20. Here the effect of varying maintenance incident rate is shown while at the same time the number of deployed systems is doubled.

*Ibid.

Table 17. Sample Test and Repair Channel Utilization and Manpower Requirements Data Table

	DS SITES				GS SITE				DEPOT			
	TEST TIME (HOUR/DAY)	NO. OF TEST MEN	REPAIR TIME (HOUR/DAY)	NO. OF REPAIR MEN	TEST TIME (HOUR/DAY)	NO. OF TEST MEN	REPAIR TIME (HOUR/DAY)	NO. OF REPAIR MEN	TEST TIME (HOUR/DAY)	NO. OF TEST MEN	REPAIR TIME (HOUR/DAY)	NO. OF REPAIR MEN
CASE I	15.4	3.85	16.9	4.23	6.3	1.58	18.6	4.65	30.1	7.53	50.2	12.55
NO. OF MEN PER SITE	8.08				6.23				20.1			
TOTAL MANPOWER	16.15				6.23				20.1 (42.48)			
CASE II									86.6	21.65	102.4	25.60
NO. OF MEN PER SITE									47.25			
TOTAL MANPOWER									47.25			

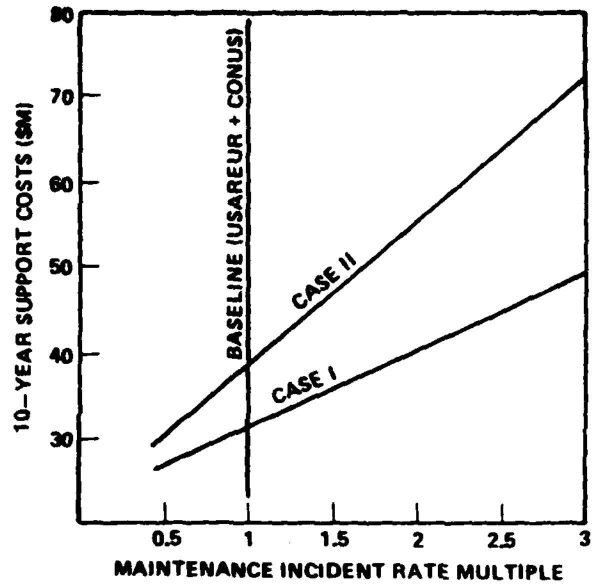

Figure 18. Effect of Maintenance Incidence Rate Variation.

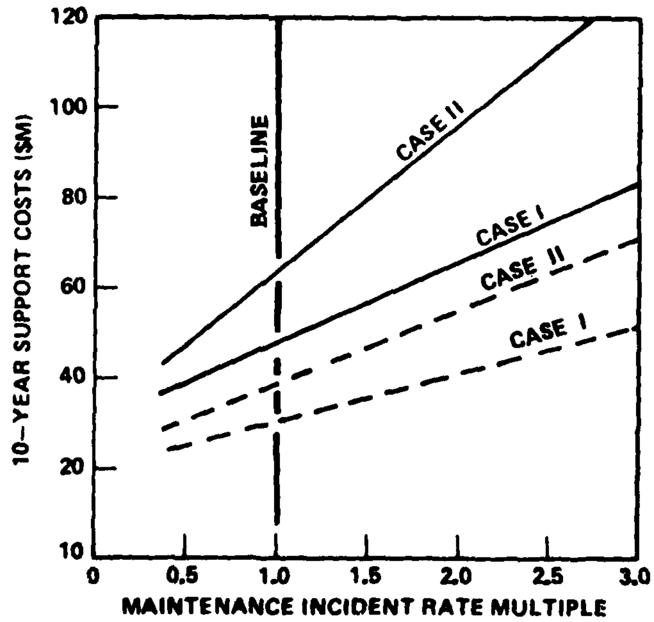

Figure 19. Effect of Simultaneous Variation of Maintenance Incident Rate and Doubling the Number of Deployed Systems.

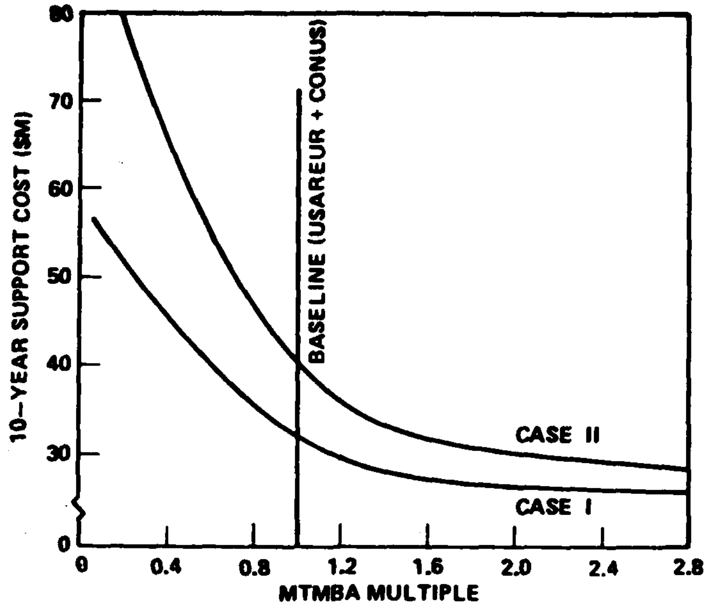

Figure 20. Effect of MTMBA Variation.

7.2.3.2 Present Value Sensitivity Effects. Sensitivity testing may also be used to show costs in relation to present value (inflation or discounting). The aspect of discounting refers to the application of a selected rate of interest to measure the differences in importance or preference between dollars at present time or anticipated dollars in the future. For the result shown in Figure 21, the yearly interest rate, FINT, was input negatively (inflation) and positively (discounting) around the center value of FINT = 0. The present value expressions are contained within the basic formulation and can be activated by inputting FINT as the sensitivity test input variable (definition for FINT in Appendix B).

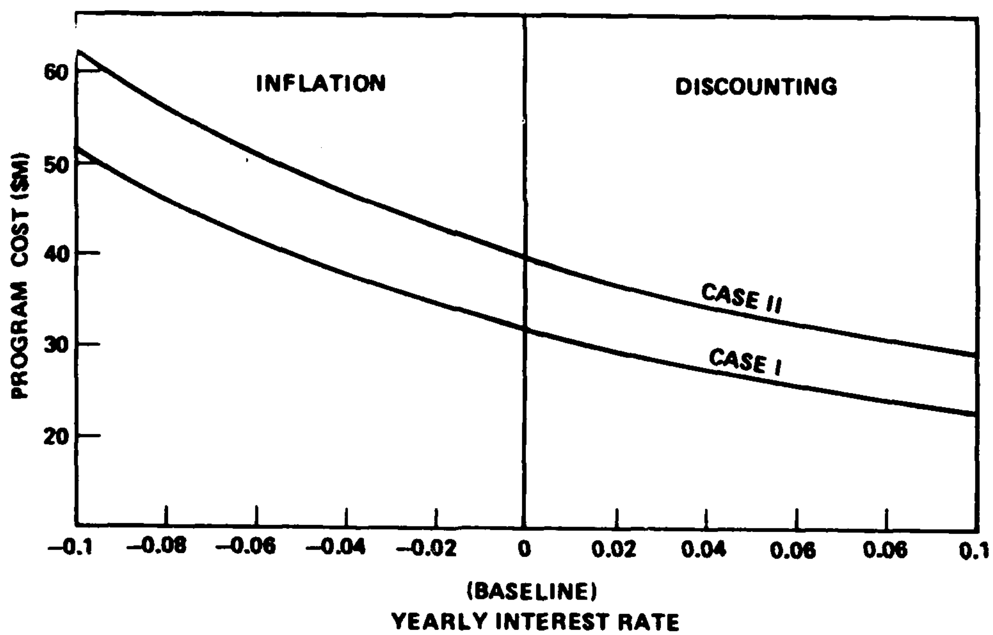

Figure 21. Sensitivity Run Showing Present Value Theory Effects

Appendix A

DEFINITION OF OUTPUT AND OTHER SYMBOLS USED

AAIE	An internal control whose value may = 1.0 or 0.0 only. Value set by input value of JTED (Appendix B) to govern computations of Type I and/or Type II test equipment (and repair) loading.
ATE	Automatic Test Equipment.
AMULT	Scale factor for all costs on output listings.
ANLYIS	A nonrecurreing identifier signifying the type of analysis or name of analyst on output listings.
CAYZ	System or subsystem operational availability.
CAYZI	System or subsystem inherent availability.
CD	Cost for development of the installed equipment and test equipment plus software.
CED	Cost for development of the installed LRUs.
CEP	Cost for procurement of the installed LRUs at all installations.
CET	Subtotal cost of LRUs, includes development procurement and end of life salvage.
CEV	End of life salvage value of the installed LRUs.
CFR	Cost of facility support based on the square footage of floor space at the depot.
CFT	Subtotal facilities cost.
CIVP	Cost of initial provisions of LRUs, modules, and parts.
CIVR	Cost of consumed material during O&M phase.
CIVT	Cost of initial provision plus the cost of consumed supplies less salvage value of residual inventory.
CIVV	End of life salvage of residual inventory.
CMPPY	Nonrecurring training costs.
CMPR	Cost of maintenance manpower during O&M phase.
CMPRR	Cost of repair manpower during O&M phase.
CMPT	Subtotal of manpower costs including nonrecurring training.

COSTIS Narrative description of dollar units (100s, 1000s, etc.).

COU Check out unit (LRU).

CP The total acquisition (production) costs (Section 6).

CR The total cost for operations and maintenance (Section 6).

CROR Cost of reordering supplies during O&M phase.

CROT Subtotal cost of reordering supplies.

CS Total end of life salvage value.

CSAP Cost of retention of items in the inventory for supply administration.

CSAT Subtotal cost for supply administration.

CSHR Costs of shipping and handling.

CSHT Subtotal cost for shipping and handling.

CSVR Recurring salvage value based on items consumed.

CTSD Development cost of test equipment.

CTSOFT Cost of technical data (documentation) or software (programming).

CTSP Production cost of test equipment.

CTSR Costs related to test equipment support.

CTST Subtotal for all test equipment costs.

CTSV End of life salvage value of test equipment.

CUM Signifies that the quantity printed on the output listing is cumulative.

CWHR Cost for storage of materials or supplies.

CWHT Subtotal cost for storage.

DELTA Differential between dedicated and expected value manpower.

EACH Signifies that the quantity printed on the output listing pertains to the individual LRU.

FIM Fault isolate an LRU to the failed module.

FIP Fault isolate an LRU to the failed part.

GCT Grand cost total for the system over the life cycle.

IA7,IA8	These are mutually exclusive flags (when IA7 = 1, IA8 must be = 0 and vice versa). A value of unity indicates which of the tapes (7 or 8) the summary LRU data may be found on.
ISET,IATE	These are internal flags which control which tape (7 or 8) the summarization process (of LRUs) is to read from and written to tape. If ISET = 1, the program reads from 7, adds data, and writes on 8. If ISET ≠ 1 and IATE = 1, the program reads from 8, adds data, and writes to 7. If both ≠ 1, this is the first pass and LRU data are written on tape 7.
ICN	A counter of LRUs and is compared to NDLRU to determine when the last LRU has been processed.
ILS	Integrated Logistics Support.
KAD	A variable which may have the values 1, 7, 8, or 9 only. The values (except 1) are assigned in the sensitivity section to determine the next starting point. 1 - is a normal start for a new LRU. 7 - restarts the program in the sensitivity section to start the application of new SENSY rules. 8 - Restarts the program in the sensitivity section to start another LRU whose values are to be changed per 7. 9 - restarts the program at the beginning after all sensitivity tests have been performed. It permits reading in a completely new set of data.
/L/	NAMELIST - a listing of all LRU inputs (Appendix C).
/LL/	An abbreviated listing of NAMELIST inputs.
LCC	Life cycle costs.
LOCAM	Logistics Cost Analysis Model.
LRU	Line replaceable unit.
MTBF	Mean time between failures.
MTBMA	Mean time between maintenance actions.
MWO	Modification work order.
O&M	Operations and maintenance.
ORLA	Optimum repair level analysis.
PVCD	Present value cost for development.

PVCP Present value cost for recurring operations.

PVCR Present value cost for recurring operations.

PVCS Present value cost for salvage.

PDELTA Present value of manpower differential (see DELTA).

PVGCT Present value of grand cost total.

REMARK Descriptor to identify qualifying information for the LRU under analysis (Appendix C).

SENSY The name of the sensitivity testing array (Section 4).

TEXT The name of the output printout page header information (Appendix C).

TOTAL Indicates that a summation of each LRU for all theaters/cases is called (Appendix C).

UNITIS Descriptor to identify the name of the LRU on the output listings (Appendix C).

<u>Functions and Subroutines</u>

BASIC Called twice to compute:

1) Dollar/pound/hour/installation for shipping.

2) Quantity of LRUs, modules, and parts tied up and the number of LRUs out of operation.

SENSIT Records the variables to be altered for the sensitivity pass.

AB Typical use:

$A = AB(x)$

$A = 0.$ if $x \geq .1 * 10^{-19}$

Otherwise

$A = 1.$

DEF Called with quantity of stock on hand and the expected value of demand for stock.

Provides the number of demands that will find no stock.

D Typical use:

$A = D(x)$
$A = x$ if $x > .1 * 10^{-19}$

Otherwise

$A = 1.$

PAGE Prints page number, heading (TEXT), DATE, "ANLYIS", UNITIS and REMARK information.

IOL Computes LRUs, modules, parts to be stocked per LOCAM 5 rules.

SPOL Typical use: Determines effect of "built-in spares" (FN) and multiple LRUs on availability.

SUPI Prints supplementary page when maintenance policies GC, GI, GJ or GK have been initiated.

OPER Controls the operation of the Operation and Support (O&S) Cost part of the model.

Subroutine One Computes total people/category and pay and allowances in the O&S Cost Part of the model.

Subroutine Two Computes personnel related cost (O&S model).

Subroutine Three IBUG

Subroutine Four Computes cost of Ammunition (O&S model).

Subroutine Five Sums instrumentation cost temporarily (O&S model).

Subroutine Six Computes Arty/Ord and follow-on-training firing cost of missiles (O&S model).

Subroutine Seven Prepares the output list in the proper units of cost (O&S model).

Subroutine Eight Prints the output list (O&S model).

Appendix B

LOGAM INPUT DEFINITIONS

An asterisk (*) preceding a variable indicates it can be read only by $LE NAMELIST. A double asterisk (**) preceding a variable means it can be read by both $LE and $L NAMELIST. No asterisk preceding a variable means it can be read only by $L NAMELIST.

ARA — Annual military manpower turnover fraction for field test and repair.

ARAD — Annual civilian manpower turnover fraction for depot test and repair.

AYZP — Control to specify the method for computing the initial provision quantities. It generally is input as a signed whole number as follows:

AYZP = 1. Use MICOM Maintenance Rules.

AYZP = 0. Use LOGAM Supply Rates.

AYZP = -1. Provision quantities are to be input.

AYZP may also contain a fractional part. The absolute value of the fraction is used to control override of stock to meet specified availability. The absolute value of the fraction states the fraction of inherent availability to be achieved.

Example

AYZP = 1.0 Use MICOM Maintenance rule. No force on availability.

AYZP = 1.9 Use MICOM Maintenance rule. Force to get 90% of the inherent availability.

AYZP = 0.73 Use LOGAM Supply Rule. Force to get 73% of the inherent availability.

CAD — Cost in dollars per year to retain an item (LRU, module, non-standard part) in the supply system.

CALMAN — Cost in dollars per year for a calibration man.

CALPUB — Cost in dollars for technical data for calibration/Type III test equipment. (CALPUB is set to zero within the program after use.)

CALSET — Number of calibration/Type III test sets and teams.

CCAL Cost in dollars to develop calibration/Type III test equipment. (CCAL is set to zero within the program after use.)

CCALP Cost in dollars to procure a calibration/Type III test set.

CCALR Cost in dollars per year to support a calibration/Type III test set.

CCSP Cost in dollars to develop contact support/Type IV test sets. (CCSP is set to zero within the program after use.)

CCSPP Cost in dollars to procure a contact support/Type IV test set.

CCSPR Cost in dollars per year to support a contact/support/Type IV test set.

CDEO Shipping from the installation to the Direct Support Activity. Input as dollars per item per pound per trip. Used in the computation of shipping and handling charges.

CDIST Cost in dollars per item per pound to distribute initial provision of LRUs, modules, and parts.

CDOE Shipping from Direct support to the installation (units as CDEO).

CDOI Shipping from Direct to General Support (units as CDEO).

CDIO Shipping from General to Direct Support (units as CDEO).

CDID Shipping from General Support to Depot (units as CDEO).

CDDI Shipping from Depot to General Support (units as CDEO).

CDFD Shipping for a one-way trip from a contractor to the government depot (units as CDEO). Applied to shipment of reprocured material.

CDMAN Cost in dollars per year for a test man at Direct Support.

CDPMAN Cost in dollars per year for a test man at Depot.

CDPRMN Cost in dollars per year for a repairman at Depot.

CDRMAN Cost in dollars per year of a repairman at Direct Support.

CEMAN Cost in dollars per year for a test man at the Equipment level.

CERMAN Cost in dollars per year for a repairman at the Equipment level.

CEN Cost in dollars to enter a line item into the supply system.

CEND Cost in dollars to develop a LRU. (CEND is set to zero within the program after use.)

CFTD Cost in dollars per square foot/month for floor space at Depot for test equipment.

CGMAN Cost in dollars per year for a test man at General Support.

CGRMAN Cost in dollars per year for a repairman at General Support.

CI Cost in dollars to develop Type I test equipment. (CI is set to zeo within the program after use.)

CII Cost in dollars to develop Type II test equipment. (CII is set to zero within the program after use.)

CKIT Cost in dollars for a modification kit.

CKMD[1] Safety stock coefficient for module stock at Depot.

CKME Safety stock coefficient for module stock at equipment level.

CKMI Safety stock coefficient for module stock at General Support.

CKMO Safety stock coefficient for module stock at Direct Support.

CKPD Safety stock coefficient for part stock at Depot.

CKPI Safety stock coefficient for part stock at General Support.

CKPO Safety stock coefficient for part stock at Direct Support.

CKUD Safety stock coefficient for LRU stock at Depot.

CKUE Safety stock coefficient for LRU stock at equipment level.

CKUI Safety stock coefficient for LRU stock at General Support.

CKUO Safety stock coefficient for LRU stock at Direct Support.

CLRUPG Cost in dollars to program and provide technical data for Type I test equipment for LRU repair.

CMODPG Cost in dollars to program and provide technical data for Type I test equipment for module repair for each module type.

1. The safety stock coefficients are used in computing initial provision quantities when using LOGAM supply rules (AYZP = 0). In this instance, stock computations are based on the sum of the mean demand quantity plus the safety stock coefficient times the square root of the mean demand quantity. This quantity is rounded off according to a rule governed by the fractional values input for the ZU, ZM, and ZP arrays.

CMP — Cost in dollars for spare or replacement module.

CONMAN — Cost in dollars per year/per man for the contact support team.

CONTCT — Number of contact support sets and teams.

CPE — Non recurring production cost in dollars for an LRU. (CPE is set to zero within the program after use.)

CPI — Cost in dollars to procure a Type I test set.

CPII — Cost in dollars to procure a Type II test equipment.

CPP — Average cost in dollars for a spare or replacement part.

CPUBII — Cost in dollars to program and provide technical data for Type II test equipment. (CPUBII is set to zero within the program after use.)

*CPUBV — Cost in dollars for technical data for Type V test equipment. (CPUBV is set to zero after use).

*CPV — Procurement cost in dollars for Type V test equipment.

CRI — Cost in dollars per year for materials to support a Type I test station.

CRII — Cost in dollars per year for materials to support a Type II test station.

CRM — Cost in dollars per module reorder action.

CRP — Cost in dollars per part reorder action.

CRU — Cost in dollars per LRU reorder action.

*CRV — Yearly cost in dollars to set up training programs for Type V test set.

CSDEP — Cost in dollars per cubic foot per month for material storage at Depot.

CSDSU — Cost in dollars per cubic foot per month for material storage at Direct Support.

CSESU — Cost in dollars per cubic foot per month for material storage at equipment level.

CSGSU — Cost in dollars per cubic foot per month for material storage at General Support.

CTCPUB — Cost in dollars to program and provide technical data for contract support/Type IV test equipment. (CTCPUB is set to zero within the program after use.)

CTRA	Cost in dollars to train one man for field maintenance.
CTRAD	Cost in dollars to train one man for Depot maintenance.
CTRCAL	Nonrecurring cost in dollars to set up training program for the calibration Type III test equipment teams.
CTRI	Nonrecurring cost in dollars to set up training program for Type I test equipment.
CTRII	Nonrecurring cost in dollars to set up training program for Type II test equipment.
CTRSPT	Nonrecurring cost in dollars to set up training program for the contact support Type IV test equipment.
*CTRV	Non recurring cost in dollars to set up training programs for Type V test equipment.
CUBEM	Storage volume in cubic feet for a module.
CUPEP	Storage volume in cubic feet for a part.
CUBEU	Storage volume in cubic feet for an LRU.
CUCE[2]	Cost in dollars per year to provide preventive or scheduled maintenance for equipment level manpower. Used in combination with SMF to model expected value manpower at the equipment level.

2. SMF and CUCE - "E" Level "Manpower" - LOGAM includes an equation for the computation of expected value of manpower at the equipment level (CMANE) in addition to the provisions of the model for the computation of integer values of contact support manpower using inputs CONMAN, TONMAN, CONTCT, etc. (Both methods may be used simultaneously when desired.)

   Input CUCE is the cost in dollars per year per equipment level team where a team means the number of men to give round-the-clock coverage. For example, if two men are needed to work together on any given problem and round-the-clock coverage requires four such sets of two men, then CUCE is the cost per year for eight men and should include any associated burden costs.

   The cost for these men will be based on the maintenance rate (CUCE) for which scheduled maintenance is required. Input SMF is the scheduled maintenance fraction. For instance, if one hour per operating day is necessary for scheduled maintenance with 250 operating days per year, 250 hours per year are required for scheduled maintenance, SMF = 250/8766 = .0285. If two men are required per team for one hour per day at $24273.00 per manyear, CMANE becomes SMF X CUCE = .0285 X $24273 X 2 = $1385.56.

CUP	Cost in dollars for the LRU under analysis (deployment, replacement, and provision LRUs).
*CV	Development cost in dollars for Type V test equipment.
DAOQL	Fraction of Depot workload that is good when delivered to the field stockage point. 1-DAOQL is recycled.
DD	Number of Depot level maintenance locations.
DDS	Number of Depot level supply points. (See Footnote 14.)
DI	Number of General Support maintenance locations.
DIS	Number of General Support supply points. (See Footnote 14.)
DTE	Pipeline in days for delays in handling repairable LRUs or modules being shipped rearward from the equipment level.
DTI	Pipeline in days for delays in handling repairable LRUs or modules being shipped rearward from General Support.
DTO	Pipeline in days for delays in handling repairable LRUs or modules being shipped rearward from Direct Support.
E	Failure rate per operating hour.
EACAL	Controls posting out one time costs for calibration/Type III test channels including manpower. Only the values zero and unity are permitted EACAL = 0 no posting of costs. EACAL = 1 forces the posting of costs. EACAL is reset to zero after each use.
EACSP	Controls posting out one time costs for contact support/Type IV test equipment and manpower. Only the values zero and unity are permitted. EACSP = 0 no positing of costs EACSP = 1 forces the posting of costs EASCP is reset to zero after each use.
ED[3]	Number of deployed equipment installations.

3. ED may represent installations of aircraft, missile systems, tanks, communications, etc. deployed to perform a specific military function or mission.

EDS	Number of equipment level supply points. (See Footnote 14.)
EE	The number of materiel systems at each deployment installation.
*ETEI	Expected value flag for test and repair men on major items at the Equipment level.
*ETE	Controls posting out of accumulated work demands for men and Type V test equipment. ETE = 0 no posting of cost ETE = 1 forces the posting of cumulative demand into the cost totals and resets the demand accumulators
*ETEI	Expected value flag for Type V test equipment on major items at equipment level.
ETI	Controls posting out accumulated work demands at service channels of Type I test equipment and their associated repair positions. Only the values zero and unity are permitted. ETI = 0 no posting of costs. ETI = 1 forces the posting of cumulative demand into the cost totals and reset the demand accumulators.
ETII	Controls posting out accumulated work demands for service channels at Depot of Type II test equipment. Only the values zero and unity are permitted. ETII = 0 no posting of costs. ETII = 1 forces the posting of cumulative demand into the cost totals and resets the demand accumulators.
EVDM[4]	Expected value flag for test manpower at Depot.
EVEM	Expected value flag for test manpower at equipment level.
EVDR	Expected value flag for repair manpower at Depot.
EVDT	Expected value flag for test equipment at Depot.
EVER	Expected value flag for repair manpower at equipment level.
EVIM	Expected value flag for test manpower at General Support.

4. Expected value flags may have only the values zero and unity. When set to unity, they give expected value (shared prorata utilization) of the service demand. When set to zero, they give integer round off, as governed by the round off input ZFL.

EVET Expected value flag for test equipment at equipment level.

EVIR Expected value flag for repair manpower at General Support.

EVIT Expected value flag for test equipment at General Support.

EVOM Expected value flag for test manpower at Direct Support.

EVOR Expected value flag for repair manpower at Direct Support.

EVOT Expected value flag for test equipment at Direct Support.

*FE The fraction of Type V test equipment manpower added for self support.

FI Fraction of Type I test equipment manpower demand that is added for self-support.

FII Fraction of Type II test equipment manpower demand that is added for self-support.

FINT[5] Yearly interest rate. Used in the computation of present value. It is the net rate between discount rate and inflation rate. Thus, if inflation exceeds discount, FINT may be input negative. Zero input gives net cost output without discount.

FMD[6] Fraction of modules that arrive at Depot that are repaired. Modules not repaired are scrapped.

FMI Module repair fraction at General Support.

FMO Specifies the module repair fraction at Direct Support.

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5. Discounting relates to the time value of money. It refers to the application of a selected rate of interest FINT such that future cost is adjusted to the present time. It also recognizes that a dollar today is worth more than future dollars because of the interest cost that is related to expenditures which occur over time. Discounting is a technique for converting costs occurring over time to equivalent amounts at a common point in time to facilitate comparison of alternative investments. The common point in time is set by the input YZ in LOGAM.

6. FMD, FMI, and FMO are module repair fractions. They specify the fraction of modules arriving at Depot, General Support, and Direct Support, respectively, that are repaired at these levels. The workflow of modules relates to the maintenance policy (G fraction). Modules not repaired at a lower echelon may be sent to a higher echelon if the maintenance policy allows it, otherwise they are scrapped.

FN[7] Number of identical LRUs within a system whose failure does not detract from system availability. Used to model effect of equipment redundancy within the system.

FNGF[8] Number to specify the ratio of false no-go LRU demands to true failures.

FNSP[9] Nonstandard part fraction related to the cost for supply administration.

FSA Field supply administration cost. Dollars per year per line item type per field supply location.

FTI Number of square feet of space required at Depot for Type I test equipment.

FTII Number of square feet of space required at Depot for Type II test equipment.

FTU Time factor in weeks used in the computation of LRU Stock at Depot. FTU is the fixed time cycle associated with LRU reprocurement. Typically, this is the factory start-up time between placement of an order and delivery of the first LRU.

FTM Analogous to FTU but is for module reprocurement.

7. FN is used in computing availability. It is a statement of the number of permissible failures at an installation before down-time counts. For redundant items, for example, FN = 1. If all failures count, FN = 0. The availability computation forgives FN failures, so to speak, before counting down-time. For a given LRU, input EE (a whole number) states the number of times a given LRU is replicated (used) per ED location. Input FN states the number of LRUs within EE whose equipment failure does not detract from system availability. For example, if there are two radio receivers per tank for the sake of redundancy of the system and one receiver out of service is permitted, then EE = 2 and FN = 1. When FN = EE, all LRUs are permitted out of service and the LRU has no role in the system availability. EE and FN must be input as whole real numbers.

8. If FNGF equals unity, the false no-go rate will equal the true failure rate specified by E. In use in the program, FNGF is commutative with the input OTF. Thus OTF modifies the false no-go rate so that it is a real time rate.

9. FNSP is used in all cost calculations related to the cost of parts. FNSP = 1. gives the full cost. FNSP = 0. deletes all costs. Intermediate values act directly. The purpose of FNSP is to account for supply administration cost for new items to be introduced in the supply system which are unique to the system under analysis. Inputs CEN and CAD are charged for FNSP times input PP as supply administration.

FTP Analogous to FTU and FTM but is for parts reprocurement.

FUD[10] LRU repair fraction at Depot.

FUE[10] LRU repair fraction at equipment level.

FUI[10] LRU repair fraction at General Support.

FUO[10] LRU repair fraction at Direct Support.

GA Specifies a policy of discard at failure. There are no maintenance support activities. All failures, false no-go indications, and attrition rate inputs result in LRU discard. Only LRUs are stocked in the supply system. There is no demand for modules or parts.

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10. FUD, FUE, FUI, and FUO are the LRU repair fractions. They specify the fraction of LRUs arriving at Equipment Level, Direct Support, General Support, and Depot, respectively, that are repaired at these levels. Like the module repair fraction FMO, FMI, and FMD, the workflow of LRUs relates to the maintenance policy (G fraction). LRUs not repaired at a maintenance echelon are scrapped.

    In all cases, the term LRU repair includes detection of false no-go items unless it has been preceded by a checkout at the Direct Support level. Also, whenever module repair succeeds LRU repair, any LRUs not repaired at the lower level will also go to the module repair facility for LRU repair. Thus, for example, for maintenance policy GP any LRUs not repaired at the General Support will go to Depot for repair. In all cases, the degree of repair performed at any level either on LRUs or on modules will be set by other input repair fractions. Whenever LRU repair is indicated, the program computes the module stock required to perform LRU repair by module replacement. Similarly, whenever module repair is indicated, the program computes the part stock required to perform module repair. Parts are always nonrepairable and are discarded.

    The specification of a maintenance concept, input by the GA through GT fractions, may be mixed in any proportion summing to unity to represent the flow of work demand. For example, if:

    GL = 0.6, GR = 0.25, GT = 0.15

    Then, 60% of the LRU removals would be sent to Direct Support for repair, 25% would be sent to General Support for repair, and the remaining 15% would go to Depot. If FUO = .8 then eighty percent of the total LRUs arriving at Direct Support would be repaired and twenty percent scrapped. Similarly FUI = .8 and FUD = .8 would act for General Support and Depot.

GB	Similar to GA but here is a provision to detect false no-go's at Direct Support and only failed and attrited LRUs are discarded. There is no demand for module or part stock. There is a demand for checkout service at Direct Support and the algebra uses Type I test equipment input data for this.
GC	Specifies LRU repair at equipment level by removing and replacing a defective module. The defective module is discarded.
GD	Specifies LRU repair at Direct Support by removing and replacing a defective module. The defective module is discarded.
GE	Specifies LRU repair at General Support by removing and replacing a defective module. The defective module is discarded.
GF	Specifies LRU repair at General Support with checkout performed at Direct Support to remove false no-go LRUs before sending the work to General Support. LRU repair is by removal and replacement of a defective module and the defective module is discarded.
GG	Specifies LRU repair at Depot. Defective modules are discarded.
GH	Specifies LRU repair at Depot preceded by a checkout at Direct Support to screen false *no-go*'s.
GI	Specifies LRU repair at equipment level and module repair at General Support.
GJ	Specifies LRU repair at equipment level and module repair at General Support.
GK	Specifies LRU repair at equipment level and module repair at the Depot.
GL	Specifies LRU and module repair at Direct Support.
GM	Specifies LRU repair at Direct Support and module repair at General Support.
GN	Specifies LRU repair at Direct Support and module repair at Depot.
GO	Specifies checkout to catch false no-go's at Direct Support followed by LRU and module repair at General Suppport.
GP	Specifies checkout to catch false no-go's at Direct Support followed by LRU repair at General Support and module repair at Depot.

GQ Specifies LRU checkout to catch false no-go's at Direct Support followed by LRU and module repair at Depot.

GR Specifies LRU and module repair at General Support.

GS Specifies LRU repair at General Support and module repair at Depot.

GT Specifies LRU and module repair at Depot.

H[11] An array of dimension four to specify authorized LRU supply locations.

HPM Discretionary procurement holding time in days for modules.

HPP Discretionary procurement holding time in days for parts.

HPU Discretionary procurement holding time in days for LRUs. No safety stock is applied to HPU, HPM, HPP, because it is a discretionary factor and may be waived if earlier procurement is indicated by field experience.

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11. LOGAM permits four levels of LRU supply. In the program these are the equipment, Direct, General, and Depot support locations. Array H is used to specify for each level whether or not LRU spares are permitted. Any combination from no supply locations to all four is permitted. Array H has dimension four. The first element is for the E level. The second element is for the Direct Support level. The third element is for the General Support level. The fourth element is for the Depot level.

Zero means not authorized. Unity means "yes" stock is authorized. Only zero or unity are to be used.

H is input via a NAMELIST/L/. Typically,

```
H = 0., 3*1.,
```

allows LRU supply at Direct Support, General Support, and Depot levels only. The input

```
H = 1., 3*0.,
```

allows LRU spares at the equipment (E level) and denies them to the Direct Support, General Support, and Depot levels.

The program will inspect the inputs QTE, QTO, QTI, ad QTD to see if stock quantities have been input. If they have been input, the corresponding H element will be set to unity even if input as zero. This change to H, if made, is permanent until H is again input with some subsequent LRU.

IBG — A FLAG, which when set to 1, causes the printout of the current values of internal variables.

IFLAG — The summation (total pages) of costs, etc. for each LRU for all theaters is suppressed.

1 Suppresses total pages.
0 Prints total pages.

ILE — Input and output control flag for $LE NAMELIST.
ILE = 1 in $L NAMELIST data will read upcoming $LE NAMELIST data.
ILE = 0 in $LE NAMELIST the program skips an attempt to read the next $L NAMELIST block. Initially, ILE is set off. If IBG and ILE are set to 1 then $LE input data is written.

INHIB — An integer to control the printout of individual LRU output. Only the numbers 0 and 1 are permitted. INHIB = 0 prints the LRU output page. INHIB = 1 inhibits the printout of LRU output.

IO — An integer to control printout of the input NAMELIST data.

IO = 0 Inhibits NAMELIST printout.
IO = 1 Abbreviated NAMELIST is printed.
IO = 2 Program will print all variables in the NAMELIST.
IO = 3 Entire sequence of input data for all LRUs printed out.

IOPER — Selects the option to add operational costs to the LOGAM output.

IOPER = 1 initiates the subroutine to compute the operation and support costs derived from a typical TOE structure. The O&S costs computed conform to DA PAM 11-4.

IS — An integer to control reset functions for maintenance concept fractions, case total accumulators, availability accumulators, workload accumulators, and recall of saved input values.

IS = 1 Anticipatory control for the next LRU. All inputs used for the first LRU of the deck are recalled for use with next LRU plus any input values keypunched for that LRU.

IS = 1 also resets availability and workload accumulators and case total accumulators.

IS ≠ 2 Resets maintenance concept fractions.
IS = 2 Retains maintenance concept fraction from one LRU to the next.
IS = 3 Nutralizes all reset actions. It must be set to 3 in first LRU data block to assure correct accumulator function (Program flow chart).

IPAGE An integral control for assigning the number of first page of output printout.

JTED An integer control used to designate the type and location of test equipment.

JTED = 1 Permits location of Type I test equipment at the Direct Support, General Support, and Depot sites.

JTED = 2 Permits location of Type I test equipment as in JTED = 1 and Type II test equipment at Depot.

NA[12] An integer to control the number of system availability modes to be tallied for the case being run.

NB[13] An integer to control initialization of default values.

NU An integer to control printout of case totals and grand totals pages, reset the grand total accumulators and provide the means for a positive program stop.

NU = 1 Suppresses print of totals page.

NU = -1 Prints the case totals page. This value may be used at any time to examine the contents of the totals accumulators. The printout of the case totals page is not accompanied by any change in the accumulators or any other program variable.

12. NA is used in combination with the input TAYZ (the availability tally control). In LOGAM, there are ten availability accumulators, therefore, it is possible to take up to ten availability products for different sets of LRUs. NA is the input which specifies how many of the ten accumulators are active.

13. In LOGAM, all program inputs obtain initial values in a BLOCK DATA sub-program. All inputs are stored in an array immediately after the read of input data for the first LRU either from BLOCK DATA or NAMELIST/L/. Input of IS = 1 with one LRU recalls the list of saved values prior to the read of the next LRU. Thus, the set of inputs for the first LRU including the standard values not input via NAMELIST/L/ become the "reset" standard values. These "reset" standard values may be redefined at any time throughout the program by use of the control NB. NB is in NAMELIST/L/ and may be input with any LRU. The exact value NB = 0 (an integer) will force the storing of the current data set for that LRU as the new set of "reset" values. NB is set to 1 during this storing and the input need not be turned off by the user.

NU = -2 Prints the case totals page as for NU = -1 and also prints a grand totals page following the case totals page. Reset of the case total accumulators is accomplished by the control IS. IS is input with the last LRU in a case deployment as IS = 1 to accomplish the reset of the case total accumulators after printout of the case totals pages.

NU = -3 Provides the same function as NU = -2, i.e, it prints out both the case total and the grand total pages. Additionally, it resets the grand total accumulators.

NU = -4 Provides a positive program stop; used in combination with a dummy REMARK card and a dummy UNITS card followed by a NAMELIST card with NU = -4.

OD Number of Direct Support Maintenance locations.

ODS[14] Number of Direct Support supply or stock transfer points.

14. DDS, DIS, EDS, and ODS determine the number of stock locations at each echelon. These inputs work with the H Array to designate if stock is permitted at a location. If DIS = 3, meaning three general support stock locations, and H(3) = 1 stock will be located at all three general support locations. If H(3) = 0 stock will be denied. If DIS = 3 and H(3) = 0 stock will be denied. The objective of this is that an analysis may require a policy of stock at a location and an alternate policy of no stock at that location. Simply changing the H Array permits quick turn-around.

OL[15] An array of dimension four representing the operating level of supply in days for consumables at Organization, Direct, General and Depot supply points.

OST[15] An array of dimension four representing the order and ship time in days for Organization, Direct, General, and Depot supply points.

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15. The input AYZP = 1 activates the use of the LOGAM maintenance rules. Then using the LOGAM maintenance rules, four maintenance turn-around times are provided.

TATE - Used for time required to obtain an LRU or module (based on maintenance policy) from "ED" stock or a support facility.
TAT - Array of dimension four used for maintenance turn-around-time at Organization, Direct Support, General Support, and Depot, respectively.

TATE and TAT are input in days. According to Array H setting authorized supply points, the contents of the repairable pipelines are computed using these maintenance turn-around times. Consumables are supplied according to the Operating Level (OL), Safety Level (SL), and Order Ship Times (OST). (The last is also used at the Depot level for repairables.)

OL, SL, and OST are arrays of dimension four. The order of each array designates the days of supply allowance for Organization, Direct Support, General Support, and Depot, respectively. The total content of the repairable and consumable pipelines is computed for LRUs, modules, and parts.

The program attempts to pass this quantity out to the authorized supply points beginning with the forwardmost location. It integerizes at each location using the round-off rules. After each point, a test is made to see if the entire demand has been equaled or exceeded. If it has been met, no further quantities are computed. This prevents oversupply of stock on top of stock. The concept is that all stock is under the control of the NICP and that stock will be directed to where needed from where stocked.

Note that when the LOGAM maintenance rules are used to compute the initial provision, the inputs TEO, TOE, TOI, TIO, etc. pipeline times are used for the computation of availability. These times specify the "down-time" consequence of a stock outage. The time should be the maximum time, as the model will adjust the time for the fullness of the pipeline.

Thus, TAT, OL, SL, OST, STAT, DTE, DTI, and DTO never enter directly into the availability calculation. The effect of these times is the computation of an integer number of spares. The number of spares enters into the computation of availability. In this way the user of the model may input policy times for setting the supply levels and input expedited times for the consequences of supply outage on availability.

OTF	The fraction of real time that deployed equipment operates.
P	Number of module types per LRU.
PP	Number of part types per LRU. (Unique parts, exclusive for system).
PUR PMR PPR	Production rates for LRUs, modules, and parts. These are not normally input because the program overrides the input if the production rates are insufficient to meet the demand and uses a value computed by the program.
QMM	The minimum reorder quantity for modules.
QMP	The minimum reorder quantity for parts.
QMU	The minimum reorder quantity for LRUs.

QTE[16] Total organization level LRU stock quantity for all EDS locations.

QTO[16] Total Direct Support level LRU stock quantity for all ODS locations.

QTI[16] Total General Support level LRU stock quantity for all DIS locations.

QTD[16] Total Depot level LRU stock quantity for all DDS locations.

QTME[16] Total organizational level module stock quantity for all EDS stock locations.

QTMO[16] Total Direct Support level module stock quantity for all ODS locations.

QTMI[16] Total General Support level module stock quantity for all DIS locations.

QTMD[16] Total Depot level module stock quantity for all DDS locations.

QTPO[16] Total Direct Support level part stock quantity for all ODS locations.

QTPI[16] Total General Support level part stock quantity for all DIS locations.

QTPD[16] Total Depot level part stock quantity for all DDS locations.

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16. QTE, QTO, QTI, QTD, QTME, QTMO, QTMI, QTMD, QTPO, QTPI, QTPD - Stock Quantities: In LOGAM, these stock quantities may be input at any time regardless of the value of AYZP. LOGAM sets each of these to zero just prior to the read of the input NAMELIST. If any one is input, it will be used as input instead of being computed. It is the responsibility of the user to input values compatible with his concept (GA through GT), i.e., unless Direct Support is performing repair to the piece part level, it would be meaningless to input a value for QTPO. However, such an erroneous input would be accepted and used by the program.

After the read of the input NAMELIST, the LRU stock quantities are inspected to see which are non-zero. If any are non-zero and this is inconsistent with the input Array H (Page), the corresponding values of Array H are altered. For example, if Array H has been input to prohibit LRU spares at Direct and QTO is input givening LRU spares to Direct, then Array H is permanent until altered by some subsequent input of Array H via NAMELIST with some subsequent LRU. When AYZP has a fractional part to call for a force on availability, the forwardmost LRU stockpile will be increased if necessary to try to meet the specified availability. In the event that the initial quantity for the forwardmost pile has been input, it will be subject to revision upwards.

RDD	Delay time in days between request for an LRU at a maintenance Depot and handling of the request by the supply point used in the computation of availability in reckoning down-time at the Depot.
REPEAT	Number of identical LRUs in each materiel system.
*RF	The fraction of TRC that is devoted to LRU remove and replace time excluding fault isolate and retest time.
RID	When using LOGAM supply rules, RID is input in days and is a specification used to distinguish between the supply allowance for condemned modules and parts and the number of days of supply for LRUs and for repaired modules at the General Support level. Within the program, RID is summed with the input TDI to form the term RIDT which sets the days of supply at General Support for condemned modules and parts.
ROI	Like RID, ROI is a specification used to distinguish between the supply allowance for condemned module and parts and the number of days of supply for LRUs and for repaired modules at the Direct Support level. Within the program, ROI is summed with the input TIO to form the term ROIT. ROIT sets the days of supply at Direct Support for condemned modules and parts.
REO	REO is similar to ROI but in this instance, it sets the days of supply at the equipment level for condemned modules.
SENSY	An array organized in the NAMELIST format used to conduct sensitivity runs (Section 4).
SL	An array of dimension four representing the safety level days of supply for consumables at Organization, Direct, General and Depot supply points (definition of OL).

SMD[17] Module scrap fraction at Depot.

SME[17] Module scrap fraction at Organization level.

SMI[17] Module scrap fraction at General Support.

SMO[17] Module scrap fraction at Direct Support.

SMF Scheduled maintenance fraction (CUCE definition).

SPE[18] Fraction for controlling the sunk portion of the prime equipment cost. Any fraction may be used for SPE, SPEV, and SPEVR.

SPE = 0 charges zero (sinks) the cost of the deployed prime equipment.

SPE = 1 charges full cost for deployed equipment.

SPEV[18] Factor to control sinking of cost of the initial provision.

SPEV = 0 no cost for the initial allowance.

SPEV = 1 charges full cost.

SPEVR[18] Factor to sink costs for consumed material.

SPEVR = 0 charges zero cost

SPEVR = 1 charges full cost.

STAT The depot pipe in days between the depot and the rear-most facility shipping LRUs and modules to the depot.

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17. The scrap fractions, SME, SMO, SMI, and SMD are applied to the work flow sent to Organization, DS, GS, and Depot by the maintenance policy G fractions prior to any application of the repair fractions FMO, FMI, and FMD. Thus, the total module scrap is the flow arriving at a maintenance point times the scrap fraction plus the remainder that are not scrapped but are not repaired as set by the repair fraction (if the latter are not sent on to a higher maintenance level).

18. LOGAM includes equations for the cost of prime equipment CEP, the cost of supply material CIVP, and the cost of consumed material CIVR. The input factors SPE, SPEV, and SPEVR appear in these equations as multipliers. Assigning values to the inputs less than unity, therefore, reduces the value of the cost equations or in effect sinks some portion of the cost which would otherwise be charged for materials.

SUD[19] LRU scrap fraction at Depot.

SUE[19] LRU scrap fraction at equipment level.

SUI[19] LRU scrap fraction at General Support level.

SUO[19] LRU scrap fraction at the Direct Support level.

SVE[20] Salvage fraction for cost of installed LRUs at the end of the life of the program.

SVR[20] Salvage fraction for cost of consumed material (reorder stock).

SVT[20] Salvage fraction for cost of test equipment.

SVV[20] Salvage fraction for cost of residual inventory.

TALMAN Number of test men per calibration crew.

TAT An array of dimension four representing maintenance turn-around Time in days at Organization, Direct, General, and Depot maintenance support levels. (See Footnote 15.)

TATE The number of days required for stock to be obtained at the equipment level. (See Footnote 15.)

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19. Module scrap fractions are for SMD, SME, SMI, and SMO. The same definitions apply for the LRU scrap fractions; however, it is also noted that the scrap fractions apply only to failure flow and not to false no-go flow.

20. Within the LOGAM program, a salvage computation is made on four types of equipment: installed LRUs, consumed material, test equipment, and residual inventory. The salvage fractions are used as multipliers in functions that are signed negative to reflect the sense of credit. Thus, the salvage terms are taken as some fraction of the costs for the various types of equipment.

TAYZ[21] An array of dimension ten to specify correspondence between model availabilities and the LRUs.

TC Mean test time in hours to checkout an LRU at any level for detection of false no-go LRUs. Used to compute demand for test manpower.

TD Test time in hours for LRU checkout at Depot. Used to compute demand for test manpower.

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21. TAYZ is an array of dimension ten to provide the capacity for ten availability accumulators (definition for NA specifies how many of the ten accumulators are active). A value must be entered for each of the ten availability accumulators; however, only the first NA of the ten are actually used. For example, if a system consists of eleven LRUs and if that system logically subdivides into functional subsystems, the arrangement of the LRUs in the input tray should be the first four LRUs that constitute the first subsystem, the next five constitute the second subsystem, and the last two constitute the third subsystem. Then if the user wanted to keep the availability tally for the total system and also for each subsystem, four tallies are required. He would input NA = 4. For TAYZ, he would input the following:

```
LRU NO.                        LRU NO.

1 TAYZ = 1., 1., 8*0.,         5 TAYZ = 1., 0., 1., 7*0.,
2                              6
3                              7
4                              8
                               9
                              10 TAYZ = 1., 2*0., 7*1.,
                              11
```

All LRUs would be tallied into the first accumulator, i.e., the first element of the TAYZ array is unity for every LRU. The first four LRUs would be tallied into the second accumulator, i.e., the second element of TAYZ is unity for the first four LRUs and zero for all others. LRUs five through nine would be tallied into the third accumulator, i.e., the third element ot TAYZ is unity for these LRUs and not for any others. The last two LRUs will be tallied into the fourth accumulator, i.e, the fourth element of TAYZ is unity for these two and zero for all others. Values of TAYZ beyond the fourth element are immaterial because NA = 4. On the case total page, four availabilities will print across the page. The first will be the system availability. The second will be the availability of the first subsystem. The third will be for the second subsystem. The fourth and last, will be for the third subsystem.

TDI Pipelength in days from Depot to General Support.

TDMAN[22] Manpower productivity factor or number of men per test crew at Direct Support.

TDPMI Manpower productivity factor or number of men per test equipment crew at Depot (for Type I test equipment).

TDPMII Manpower productivity factor or number of men per test equipment crew at Depot (for Type II test equipment).

TDPRI Manpower productivity factor or the number of men per repair crew at Depot for Type I test equipment.

TDPRII Manpower productivity factor or the number of men per repair crew at Depot for Type II test equipment.

TDR Repair time in hours to repair an LRU. Used to compute demand at Depot.

TDRMAN Manpower productivity factor or number of men per repair crew at Direct Support.

TEO[23] Pipelength in hours between equipment level and Direct Support when using LOGAM Supply Rules or expedited time for obtaining a spare when using LOGAM Maintenance Rules (definition of OL).

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22. In LOGAM, manpower may be input as shared or dedicated according to the value input for the expected value flags (EVDM). When shared manpower is used, the inputs such as TDMAN represent the manpower productivity to account for less than full time utilization of the maintenance manpower. Factors greater than one are input which in effect act as multipliers on the cost for manpower. For Depot and General Support, TGMAN, TGRMAN, TDPMI, TDPMII, TDPRI and TDPRII may be adjusted to account for maintenance civilian labor costs (Item 3.051 and DA PAM 11-4).

23. When LOGAM supply rules are used (AYZP = 0), TEO is used in conjunction with the input TOE to set the down-time per failure or false no-go or attrited item returned from an installation to Direct Support. (The return may be for repair, supply, or material transfer.) This down time is used to compute one of the terms in the LOGAM availability formulation and as a minimum at least this much down time is occasioned at each support demand by a unit. It is the sum of TEO, and TOE that is used in the program; they are never used separately. In particular, TEO might represent the time for a contract support team to go to an installation.

TE — Test time in hours for an LRU at equipment level. Used to compute the demand for test manpower.

TEMAN — Manpower productivity factor or number of men per test crew at equipment level.

TER — Repair time in hours for an LRU at equipment level. Used to compute the demand for repair manpower.

TERMAN — Manpower productivity factor or number of repairmen per repair crew at equipment level.

TENMAN — The men applied to MTTR effort at equipment level. This is a multiplier of the number of eight hour shifts needed to perform the work.

TF — Mean time in hours to test an LRU at Direct Support. It is the total time per service action in the test position and it is used to set the demand for test equipment and for test equipment men.

TFR — Repair time in hours for an LRU at Direct Support. Used to compute demand for repair manpower.

TGMAN — Manpower productivity factor or number of men per test crew at General Support.

TGRMAN — Manpower productivity factor or number of repairmen per repair crew at General Support.

TI — Test time in hours for an LRU at General Support. Used to compute demand for test manpower.

TID — Pipelength in days from General Support to Depot.

TIO — Pipelength in days from General Support to Direct Support.

TIR — Repair time in hours of an LRU at General Support. Used to compute demand for test manpower.

TMD — Test time in hours for module checkout at Depot. Used to compute demand for test manpower.

TMDR — Repair time in hours for a module at Depot. Used to compute demand for repair manpower.

TMI — Mean test time in hours for module checkout at General Support. Used to compute demand for test manpower.

TMIR — Repair time in hours for a module at General Support. Used to compute demand for repair manpower.

TMO — Mean test time in hours for module checkout at Direct Support. Used to compute demand for test manpower.

TMOD TMID TMDD	Direct General Depot	The time in hours for modification kit installation per repair crew at Direct, General, or Depot.

TMOR — Repair time in hours for a module at Direct Support. Used to compute demand for repair manpower.

TOE — Pipelength in hours between Direct Support and equipment level when using LOGAM Supply Rules, or expedited time for obtaining a spare when using LOGAM Maintenance Rules, hours (TEO).

TOI — Pipelength in days from Direct Support to General Support.

TONMAN — Number of men per contact support crew (Type IV test equipment).

TOMW TIMW TDMW	Direct General Depot	The mean time in hours spent in the test position (at Direct, General, or Depot) per tests sequence. The program assumes that this time will be spent twice: Once before the modification is installed and once after the modification is installed.

TRC — Down-time in hours per service demand at equipment level (equivalent to MTTR).

TUMD — Used in concepts GN, GP, GQ, GS, and GT which call for LRU and module repair at Depot. TUMD sets the supply allowance in hours for modules at Depot to cover the time between removal of a module from an LRU until the module is repaired and returned to service for servicing further LRUs.

TUMI — Used in concepts GM, GO, and GR which call for LRU and module repair at General Support. TUMI sets the supply allowance in hours for modules at General Support to cover the time between removal of a module from an LRU until the module is repaired and returned to service for servicing further LRUs.

TUMO — Used for maintenance concepts GL where both LRU and module repairs are performed at Direct Support. TUMO sets the supply allowance in hours for modules at Direct Support to cover the time between removal of a module from an LRU until the module is repaired and returned to service for servicing further LRUs.

WD[24]	The scheduled work week in hours for test equipment at Depot.
WDM	The scheduled work week in hours for test crews at Depot.
WDR	The scheduled work week in hours for repair crews at Depot.
WE	Scheduled work week in hours for test equipment at Organization.
WER	Scheduled work week in hours for repair crews at Organization.
WEM	Scheduled work week in hours for test equipment manpower at Organization.
WI	The scheduled work week in hours for test equipment at General Support.
WIM	The scheduled work week in hours for test crews at General Support.
WIR	The scheduled work week in hours for repair crews at General Support.
WM	The shipping weight in pounds of a module.
*WMR	The work week in hours for repair men performing TRC work on major items.
*WMT	The work week in hours for Type V test equipment.
WO	The scheduled work week in hours for test equipment at Direct Support.
WOM	The scheduled work week in hours for test crews at Direct Support.
WOR	The scheduled work week in hours for repair crews at Direct Support.

24. The work weeks are set in accordance with the corresponding expected value controls. When the expected value control is set to zero, the program acts in an integer round off computation mode for the service channel requirements. In this mode, one is cautioned that excessively long work weeks can lead to queues which are not computed within this program, i.e., if indeed there were a work demand requiring work 168 hours per week and the work week input as 168 hours per week, i.e., repair rate equals demand rate, then the queue would, in general, be long. When the expected value control for manpower is set to one, the work week should correspond to the manpower salary scale, i.e., if the salary scale is on the basis of a 40 hour week, then the work week should be input as 40 hours.

WP	The shipping weight in pounds of a part.
WTKIT	The shipping weight in pounds of mod kit.
WU	The shipping weight in pounds of an LRU.
YAT	The annual attrition fraction for LRUs. It represents an annual demand for reissue and reprocurement to replace attrited LRUs. It operates on the population of installed LRUs to determine the number to be replaced each year. Within the program, YAT is converted to an hourly attrition rate, A. This, in turn, is multiplied by OTF to get the real time rate.
YD	The length of the development phase of the program in years. It is only used in computing present value of costs incurred during a development phase (definition for FINT).
YMWO	The number of MWOs per year per LRU. YMWO is input as a percent per year of MWOs expected to be performed in the life cycle, i.e., if two MWOs are expected in a life cycle of 10 years, YMWO = .2.
YP	The length of the production or acquisition phase in years. It is used in computing the present value of costs incurred during the production phase. It is also used in estimating the initial production rate which is used as a reference rate in the main program in the computation of reorder buy quantities.
YR	The duration of the operation and maintenance portion of the program in years. Many of the cost computations for support are directly proportional to this input. It is also used in computing present value of operation and maintenance expenditures.
YZ	Input in the dimension of years and may be positive or negative. It is used in the computation of present value of costs to change the zero point of reference at which present value is started. The program treats YD, YP, and YR as consecutive non-overlapping time intervals. Nominally, present value is computed for the end of the production phase and the start of the operation and maintenance phase. YZ shifts this point by as many years ahead of or after it. Thus, if YZ equals the negative of YP, then present value is stated at the start of the production phase. If YZ is positive, it moves the point so many years into the O&M period from its start. Shifting YZ from LRU to LRU in the input sequence of LRUs being analyzed and using sunk cost input controls can accomplish, at present value, a time phasing of program cost totals.

ZFL[25] Round-off rule used in computing service channel quantities when integer round-off in invoked.

ZI Fraction of MWOs installed at General Support.

ZM An array of dimension three to specify the round-off fractions for modules at Direct, General, and Depot supply points (ZFL).

ZO Fraction of MWOs installed at Direct Support.

ZP An array of dimension three to specify the round-off fractions for parts at Direct, General, and Depot supply points (ZFL).

ZU An array of dimension four to specify round-off fractions for LRUs at equipment, Direct, General, and Depot supply points (ZFL).

25. The round-off rules ZFL, ZM, ZP, and ZU all act in the same manner. The values input are added to the demands computed by the program and then the fractional part is dropped and the whole number is retained. This is done to avoid acquisition of fractional portions of test equipment, LRU, modules, and parts.

Appendix C

USING LOGAM (A SAMPLE PROBLEM)

The approach to explaining the use of LOGAM is to set up a simulated sample problem and then to use the model to solve the problem in terms of life cycle logistics support costs and equipment availability. All of the steps involved in this typical application are shown to demonstrate how the model is used and the results obtained. Other applications of the LOGAM family of models are listed in the Bibliography.

1.0 Sample Problem Definition

The example problem addresses the prediction of logistic support costs for a hypothetical land combat missile system composed of several LRUs.

1.1 Operational Scenario*

The operational scenario comprises two geographical deployments:

a) A European overseas deployment USAREUR.

b) A Continental United States deployment CONUS.

Figure C-1 illustrates the repair flow associated with the USAREUR deployment. As depicted for this situation, the missile system in the field is maintained by direct exchange of failed LRUs from stock at the Integrated Direct Support Maintenance (IDSM) level. The study assumes nine IDSMs and three classes of LRUs are evaluated as follows:

a) Class 1 LRUs are repaired at the CONUS Depot.

b) Class 2 LRUs are repaired at overseas Direct Support sites by module replacement and overflow LRUs and modules are repaired at the CONUS Depot. Two DS sites are considered in the example analysis.

c) Class 3 LRUs are repaired at an overseas General Support site by module replacement and overflow LRUs and modules are repaired at the CONUS Depot.

* Note: USAREUR and CONUS deployments are included to demonstrate the maintenance portion of LOGAM and the use of TOTAL where the sum of maintenance costs for two theaters is obtained on an individual LRU basis. Sensitivity testing is also included to demonstrate this feature. And finally inputs are included to show the operation of the post processor (Section 5) to compute the operational costs. However, this mode of operation actually is valid only when a single theater is being examined as noted in Section 5. Inputs to the post processor are included in the sample problem, however, to produce an example of the total operation and support cost output obtained with the LOGAM computer program.

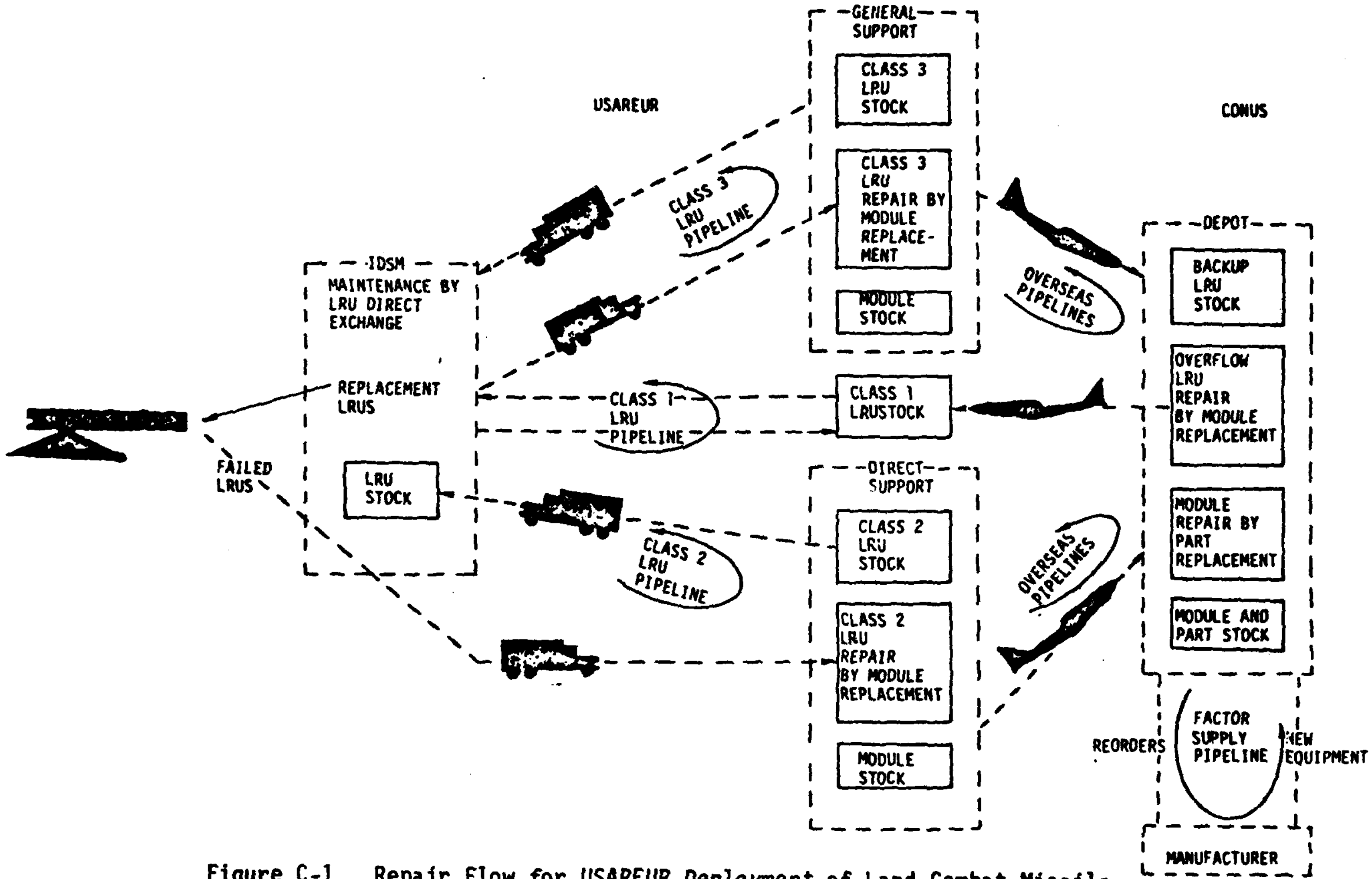


Figure C-1. Repair Flow for USAREUR Deployment of Land Combat Missile Systems. (LOGAM also includes 4 policies where LRUs can be repaired at the equipment level.)

1.2 Example Problem Data Base

Typically, the data base for a logistic cost analysis application of the LOGAM model involves several categories of information:

a) Deployment factors: Number of systems supported, geographical location, utilization rate, support hierarchy to include relation to organizational structure, and number of supply points.

b) Equipment Factors: Equipment breakdown, units, modules, parts; removal rates; physical characteristics; operating times; and costs per unit, module, and part.

c) Maintenance Factors: Turn-around times, delay times, order and ship times, operating and safety stock levels.

d) Supply Factors: Stockage policies, supply times, production lead times, stockage costs, and transportation factors.

e) LRU Modifications: Modifications or engineering change proposals of fielded LRUs and the provision quantity during the operational phase of the program.

f) Test Equipment Factors: Test equipment characteristics, costs, and support maintenance requirements.

1.2.1 Deployment Factors: The following deployment factors are involved.

a) The number of operational missile systems per installation, ED*

USAREUR - ED = 141

CONUS - ED = 40

b) The fraction of real time that each missile system is operated, OTF = 0.0548. (This is equivalent to a total operating time of 480 hours per year.)

c) Hierarchy and number of support and supply installations:

	USAREUR			CONUS	
EQUIP.	ED = 141		EDS = 141	ED = 40	EDS = 40
IDSM	OD = 9		ODS = 9	OD = 4	ODS = 4
DSU	DI = 2	(Class 1 and 2 LRUs)	DIS = 2	DI = 4	DIS = 4
GSU	DI = 1	(Class 3 LRUs)	DIS = 1		
Depot	DD = 1		DDS = 1	DD = 1	DDS = 1

As indicated by the preceding deployment factors, the LOGAM model can be used to analyze several geographic scenarios and the results combined to determine worldwide support costs for military weapons

*Symbols indicate LOGAM input mnemonic (Section 5).

systems. In the sample case the installation is USAREUR and CONUS and EE = 1. ED can represent a battalion of operational materiel systems and EE can represent the number of battalions. LOGAM provides the capability to sum the results for individual LRUs and print the results of two or more geographical scenarios. A header card is inserted as the eighth card in the input deck on which the word "TOTAL" is punched along with a number designating the number of LRUs comprising the system under analysis. The LRUs must also be given in the same sequence for each theater of operation. In the example problem, the value NU = -3 is input with the final LRU of the CONUS deployment. This activates the printout of a CONUS totals page and LRU pages for all LRUs which are the sum of the CONUS + USAREUR LRU pages and finally a "GRAND TOTAL" printout which is the sum of all costs for USAREUR + CONUS for all LRUs. If the individual LRU totals are not desired, enter IFLAG = 1 in the last box.

The principal differences between the USAREUR and CONUS scenarios is the number of deployed missile systems, the support hierarchy, several of the pipeline factors, and the prorated share of the cost to enter and keep items in the inventory. For the CONUS scenario, a deployment of forty missile systems at four training installations is assumed. Each installation has the equivalent of an IDSM and a DSU maintenance plus supply point. These are backed up by a common CONUS depot for overflow LRU and module repair. Inputs related to test equipment development are not included in the CONUS input data set because they have already been charged against the USAREUR situation.

1.2.2 Equipment Factors. The LRUs are considered in the example problem breakdown to the module and part level. The maintenance policies used for the example problem are as follows:

	USAREUR	CONUS
Class 1 LRU No. 1	GC = 1	GT = 1
Class 1 LRU No. 2	GI = 1	GT = 1
Class 1 LRU No. 3	GJ = 1	GT = 1
Class 1 LRU No. 4	GJ = 1	GT = 1
Class 2 LRU No. 1	GK = 1	GS = .85, GT = .15
Class 2 LRU No. 2	GS = .85, GT = .15	GS = .85, GT = .15
Class 2 LRU No. 3	GS = .85, GT = .15	GS = .85, GT = .15
Class 2 LRU No. 4	GS = .85, GT = .15	GS = .85, GT = .15
Class 2 LRU No. 5	GS = .85, GT = .15	GS = .85, GT = .15
Class 3 LRU No. 1	GS = .7, GT = .3	GT = 1
Class 3 LRU No. 2	GS = .7, GT = .3	GT = 1

The costs for LRUs, breakdown of LRUs by module and part types, maintenance incident rates, and test and repair times are shown in Table C-1.

The weight and cube of LRUs, modules and parts are shown in Table C-2. Weights and cubes have been factored to include packaging material weights and storage space.

Table C-1. Equipment Factors

LRU	Unit Cost ($)	Module Cost ($)	Part Cost (%)	Number Module Types	Number Part Types	Maintenance Incident Rate (hour)	Unit Test Time (hour)	Unit Repair Time (hour)	Module Test Time (hour)	Module Repair Time (hour)	Unit Test Time (hour)	Unit Repair Time (hour)
	CUP	CMP	CPP	P	PP	E	TI or TD	TIR or TDR	TMD	TMDR	TE	TER
Class 1-No.1	988	500	3.0	3	20	0.0001	0.25	0.5	0.8	1.3	1.0	1.0
Class 1-No.2	988	500	2.5	3	30	0.0001	0.25	0.5	0.6	1.1	1.0	1.0
Class 1-No.3	988	500	7.0	2	20	0.0005	0.25	0.5	0.5	0.9	1.0	1.0
Class 1-No.4	741	450	0	2	0	0.0005	0.25	0.5	0	0	1.0	1.0
Class 2-No.1	57,730	2080	12.5	15	50	0.0021	2.0	2.0	0.5	0.9	1.0	1.0
Class 2-No.2	17,613	1126	18.0	10	40	0.0017	1.8	1.5	0.5	0.9	1.0	1.0
Class 2-No.3	18,827	1500	10.5	8	40	0.0011	0.5	1.5	0.4	0.8	1.0	1.0
Class 2-No.4	12,250	1360	9.0	4	40	0.001	0.8	1.8	0.3	0.6	1.0	1.0
Class 2-No.5	5,000	1000	6.0	4	40	0.0008	1.0	1.8	0.1	0.4	1.0	1.0
Class 3-No.1	27,716	1610	6.0	12	50	0.001	0.5	1.6	0.3	0.6	1.0	1.0
Class 3-No.2	75,262	2500	11.0	13	40	0.0013	1.0	3.5	0.75	3.4	1.0	1.0

Table C-2. Weight and Cube Factors

LRU	Ship Weight (lb)			Storage Volume (ft^3)		
	LRU	Module	Part	LRU	Module	Part
LRU	WU	WM	WP	CUBEU	CUBEM	CUBEP
Class 1 - No. 1	7.5	0.1	0.05	0.12	0.005	0.003
Class 1 - No. 2	4.5	0.2	0.1	0.15	0.015	0.005
Class 1 - No. 3	3.0	0.5	0.1	0.1	0.01	0.005
Class 1 - No. 4	3.0	0.5	0	0.1	0.01	0
Class 2 - No. 1	40.0	2.0	0.1	0.75	0.02	0.005
Class 2 - No. 2	26.0	1.5	0.08	0.7	0.02	0.005
Class 2 - No. 3	36.0	2.0	0.1	0.75	0.02	0.005
Class 2 - No. 4	40.0	2.0	0.1	0.75	0.02	0.005
Class 2 - No. 5	36.0	2.0	0.1	0.75	0.02	0.005
Class 3 - No. 1	30.0	1.5	0.08	1.0	0.05	0.01
Class 3 - No. 2	150.0	15.0	0.5	15.0	0.5	0.05

LRU descriptive quantities may also be recorded by filling out the multi-LRU worksheets discussed in Section 6. Tables C-3, C-4, C-5, and C-6 show these worksheets filled out with the sample problem LRU data.

1.2.3 Supply Factors

1.2.3.1 Maintenance Times (LOGAM Maintenance Rules). LOGAM includes an additional way to compute initial provision quantities called "LOGAM Maintenance Rules". This computation is activated by setting AYZP = 1 and the requirement to define several new input data factors. The example problem includes the use of the LOGAM maintenance rules and uses the following values for the maintenance time input data factors:

TATE	= 60 days
TAT(1) = TAT(2) = TAT(3)	= 2 days
TAT(4)	= 3 days
OL(1) = OL(2) = OL(3)	= 15 days
OL(4)	= 30 days
SL(1) = SL(2) = SL(3)	= 2 days
SL(4)	= 3 days
OST(1) = OST(2) = OST(3)	= 15 days (USAREUR)
OST(3)	= 20 days (CONUS)

Table C-3. LRU Data Form No. 1

System Sample Problem

LRU	CUP	CMP	CPP	MTBF	MTBMA	E					CEND	CPE	Maintenance Policy
	($)	($)	($)	Operating (hours)	KxMTBF	$\frac{1}{MTBMA}$	P	PP	EE	Repeat	($)	($)	
Class 1 LRU No. 1	988	500	3.0	-	-	0.0001	3	20	1	1	-	-	
Class 1 LRU No. 2	988	500	2.5	-	-	0.0001	3	30	1	1	-	-	
Class 1 LRU No. 3	988	500	7.0	-	-	0.0005	2	20	1	1	-	-	
Class 1 LRU No. 4	741	450	0	-	-	0.0005	2	0	1	1	-	-	
Class 2 LRU No. 1	57,730	2080	12.5	-	-	0.0021	15	50	1	1	-	-	
Class 2 LRU No. 2	17,613	1126	18.0	-	-	0.0017	10	40	1	1	-	-	
Class 2 LRU No. 3	18,827	1500	10.5	-	-	0.0011	8	40	1	1	-	-	
Class 2 LRU No. 4	12,250	1360	9.0	-	-	0.001	4	40	1	1	-	-	
Class 2 LRU No. 5	5,000	1000	6.0	-	-	0.0008	4	40	1	1	-	-	
Class 3 LRU No. 1	27,716	1610	6.0	-	-	0.001	12	50	1	1	-	-	
Class 3 LRU No. 2	75,262	2500	11.0	-	-	0.0013	13	40	1	1	-	-	

Table C-4. LRU Data Form No. 2

System Sample Problem

LRU	WU (lb)	WM (lb)	WP (lb)	CUBEC (ft^3)	CUBEM (ft^3)	CUBEP (ft^3)	TF (hour)	TFR (hour)	TMD (hour)	TMDR (hour)	TI (hour)	TIR (hour)	TMI (hour)	TMIR (hour)	FNSP
Class 1 LRU No. 1	7.5	0.1	0.05	0.12	0.005	0.003	-	-	-	-	0.25	0.5	-	-	
Class 1 LRU No. 2	4.5	0.2	0.1	0.15	0.015	0.005	-	-	-	-	0.25	0.5	-	-	
Class 1 LRU No. 3	3.0	0.5	0.1	0.1	0.01	0.005	-	-	-	-	0.25	0.5	-	-	
Class 1 LRU No. 4	3.0	0.5	0	0.1	0.01	0	-	-	-	-	0.25	0.5	-	-	
Class 2 LRU No. 1	40.0	2.0	0.1	0.75	0.02	0.005	-	-	-	-	2.0	2.0	-	-	
Class 2 LRU No. 2	26.0	1.5	0.08	0.7	0.02	0.005	-	-	-	-	1.8	1.5	-	-	
Class 2 LRU No. 3	36.0	2.0	0.1	0.75	0.02	0.005	-	-	-	-	0.5	1.5	-	-	
Class 2 LRU No. 4	40.0	2.0	0.1	0.75	0.02	0.005	-	-	-	-	0.8	1.8	-	-	
Class 2 LRU No. 5	36.0	2.0	0.1	0.75	0.02	0.005	-	-	-	-	1.0	1.8	-	-	
Class 3 LRU No. 1	30.0	1.5	0.08	1.0	0.05	0.01	-	-	-	-	0.5	1.6	-	-	
Class 3 LRU No. 2	150.0	15.0	0.5	15.0	0.5	0.05	-	-	-	-	1.0	1.5	-	-	

Table C-5. LRU Data Form No. 3

System Sample Problem

LRU	TD (hour)	TDR (hour)	TMD (hour)	TMDR (hour)	TRC (hour)	TC (hour)	CLRUPG ($)	CMODPG ($)	CPUBII ($)	CKIT ($)	WTIKIT (lb)	ZI	ZO	CTF	SPE
Class 1 LRU NO. 1	0.25	0.5	0.8	1.3	1	-	-	-	-	148	1	0	0		
Class 1 LRU No. 2	0.25	0.5	0.6	1.1	1	-	-	-	-	148	1	0	0		
Class 1 LRU No. 3	0.25	0.5	0.5	0.9	1	-	-	-	-	148	1	0	0		
Class 1 LRU No. 4	0.25	0.5	0	0	1	-	-	-	-	111	1	0	0		
Class 2 LRU No. 1	2.0	2.0	0.5	0.9	1	-	-	-	-	5773	10	0.5	0		
Class 2 LRU No. 2	1.8	1.5	0.5	0.9	1	-	-	-	-	1716	10	0.5	0		
Class 2 LRU No. 3	1.8	1.5	0.4	0.8	1	-	-	-	-	1883	10	0.5	0		
Class 2 LRU No. 4	0.8	1.8	0.3	0.6	1	-	-	-	-	500	10	0.5	0		
Class 2 LRU No. 5	1.0	1.8	0.1	0.4	1	-	-	-	-	500	10	0.5	0		
Class 3 LRU No. 1	0.5	1.6	0.3	0.6	1	-	-	-	-	2772	10	0.7	0		
Class 3 LRU No. 2	1.0	3.5	0.75	3.4	1	-	-	-	-	7526	30	0.7	0		

OST(4)	= 30 days
STAT	= 30 days (USAREUR)
STAT	= 20 days (CONUS)
DTE	= 6 days
DTO	= 60 days (USAREUR)
DTO	= 30 days (CONUS)
DTI	= 60 days (USAREUR)
DTI	= 30 days (CONUS)

Table C-6. LRU Data Form No. 4

System Sample Problem

	TMOD (hour)	TMID (hour)	TMDD (hour)	TOMW (hour)	TIMU (hour)	TDMW (hour)	TE (hour)	TI (hour)
Class 1 LRU No. 1	--	1	1	--	0.5	0.5	1	1
Class 1 LRU No. 2	--	1	1	--	0.5	0.5	1	1
Class 1 LRU No. 3	--	1	1	--	0.5	0.5	1	1
Class 1 LRU No. 4	--	1	1	--	0.5	0.5	1	1
Class 2 LRU No. 1	--	1	1	--	0.5	0.5	1	1
Class 2 LRU No. 2	--	1	1	--	0.5	0.5	1	1
Class 2 LRU No. 3	--	1	1	--	0.5	0.5	1	1
Class 2 LRU No. 4	--	1	1	--	0.5	0.5	1	1
Class 2 LRU No. 5	--	1	1	--	0.5	0.5	1	1
Class 3 LRU No. 1	--	1	1	--	0.5	0.5	1	1
Class 3 LRU No. 2	--	1	1	--	0.5	0.5	1	1

1.2.3.2 Production Lead Times. Administrative and production lead times are those required for purchasing consumed spares. Factory start-up times include time from initiation of contract to delivery of first production run. The baseline example problem assumes the following values:

LRU, FTU = 64 weeks (USAREUR), 56 weeks (CONUS).

Modules, FTM = 38 weeks (USAREUR), 30 weeks (CONUS).

Parts, FTP = 20 weeks (USAREUR), 12 weeks (CONUS).

1.2.3.3 Transportation Factors. Shipping and handling costs to and from USAREUR and CONUS depot by air and to the depot from the contractor by truck in CONUS were used. Air costs to and from USAREUR per round trip were assumed to be:

I + I = $0.66/lb/trip

and for the factory to depot trip:

F = $0.63/lb/trip (USAREUR), $0.33/lb/trip (CONUS).

1.2.3.4 Supply Administration. The cost to enter a line item in stock, EN = $1077 (USAREUR) and EN = $451 (CONUS). The cost to retain an item in the supply system A = $436 (USAREUR) and A = $170 (CONUS). Reorder costs are as follows:

LRUs, RU = $835 per action.
Modules, RM = $835 per action.
Parts, RP = $835 per action

1.2.3.5. Minimum Order Quantities. The example problem uses the following input values:

LRUs QMU = 20
Modules QMM = 50
Parts QMP = 100

1.2.3.6 False No-Go Factors. The example problem uses a value of 20% for this factor:

FNGF = 0.2

1.2.4 LRU Modification Workload. The LOGAM model also has the capability to accomodate the workload associated with modifications (MWOs) to the fielded and pipeline LRUs during the oprational life cycle. In the example problem, several MWO factors were assumed to be the same for all LRUs.

The MWO rate per year,	YMWO	= 0.2
The MWO field or depot test time	TIMW	= TDMW = 0.5 hour.
The MWO field or depot repair time	TMID	= TMDD = 1 hour

Other MWO factors varied with the type of LRU. These are shown in Table C-7.

1.2.5 Test Equipment Factors. LOGAM uses an integer control JTED to designate the type and location of the test equipment. Five types of test equipment can be accommodated in the LOGAM model:

a) Type I can be located in field or depot and is sometimes* used to represent automatic test equpment.

b) Type II can be depot located only and is sometimes* used to represent factory type manual test equipment.

c) Type III can be located in field or depot and is generally used to represent calibration equipment.

d) Type IV is generally used to represent contact support sets in the field.

e) Type V is generally used to represent built-in test equipment.

TABLE C-7. Inputs Related To Modification Workload - MWO

	MWO Performed in Field (%)	Cost of MWO Kit ($)	Shipping Weight of MWO Kit (lb)
LRU	ZI	CKIT	WTKIT
Class 1 - No. 1	0	148	1
Class 1 - No. 2	0	148	1
Class 1 - No. 3	0	148	1
Class 1 - No. 4	0	111	1
Class 2 - No. 1	0.5	5773	10
Class 2 - No. 2	0.5	1716	10
Class 2 - No. 3	0.5	1883	10
Class 2 - No. 4	0.5	1225	10
Class 2 - No. 5	0.5	500	10
Class 3 - No. 1	0.7	2772	10
Class 3 - No. 2	0.7	7526	30

The maintenance policies and the integer control JTED control the location of the first two types of test equipment as follows:

a) If the value of JTED is input as 1, then Type I can be located in the Depot.

*Test equipment input factors are generic and development, acquisition, and documentation or software cost factors can be subject to varied interpretations.

b) If the value of JTED is input as 2, Type II can be located in Depot.

c) Type I test equipment can be field located regardless of the JTED value.

For the example problem, the following inputs pertaining to test equipment apply:

1.2.5.1 USAREUR/CONUS (JTED = 2). Type I test equipment represents the test equipment at the DS sites:

Test Equipment Development Cost, (charged only in USAREUR portion of run)	CI =	$1,824,000
Test Equipment Acquisition Cost Per Set,	CIP =	131,500
Annual Cost for Test Equipment Maintenance for Consumed Materials Per Set,	CRI =	6,000

Type II test equipment represents the test equipment at the depot:

Test Equipment Development Cost, (charged only in USAREUR portion of run)	CII =	$1,370,000
Test Equipment Acquisition Cost,	CPII =	246,000
Annual Cost for Test Equipment Maintenance for Consumed Material,	CRII =	7,500

Type III test equipment represents the test equipment at the GS site:

Test Equipment Acquisition Costs,	CCALP =	$220,000
Annual Cost for Test Equipment Maintenance for Consumed Material	CCALR =	2,000

Type IV test equipment represents the test equipment at the IDSM sites:

Test Equipment Development Cost, (charged only in USAREUR portion of run)	CCSP =	$425,000
Test Equipment Acquisition Cost Per Set	CCSPP =	100,000
Annual Cost for Test Equipment Maintenance for Consumed Material Per Set,	CCSPR =	1,000

1.2.5.2 <u>Test and Repair Manpower and Training</u>. The expected value option was used to accumulate manpower costs on a prorated basis depending on cumulative workload for the example problem. In effect, this implied that manpower costs, adjusted for suitable productivity factors, are accrued for the cumulative test and repair man hours. If the workload is such that only a fractional part of the available

manhours per year is used, then a fractional part of the annual salary of a test or repairman is charged.

Org. Level Test and Repairman,	CENMAN = \$16,600
	CERMAN = \$16,600
DS or GS Test and Repairmen,	CDMAN = CGMAN = \$16,600
	CDRMAN = CGRMAN = \$16,600
Depot Test and Repairmen,	CDPMAN = \$26,100
	CDPMAN = \$26,100
Manpower Productivity Factors,	TGMAN = 2
	TGRMAN = 2
	TDMMI = 2
	TDRMII = 2
	TDPRI = 2
	TDPRII = 2

The annual turnover factor for field test equipment manpower, ARA = 0.4. The annual cost to train one man for field maintenance, CTRA = \$2350.

2.0 Program Output for Sample Program

The OUTPUT and TOTALS printout instructions have been placed in-line to the main program. Along with the printouts of study results NAMELISTS/L/ and /LL/ can be printed depending on the value input for the control IO. A formatted listing of the entire sequence of input data for all LRUs up to and including the present LRU will be printed out in columnar fashion. Inputting the value IO = 3 activates this section of the model and this feature greatly facilitates the examination of an entire sequence of input values.

2.1 Input Deck Structure

A listing of the input data deck used for the example problem is shown in Appendix D. The general structure of the input deck is as follows:

2.1.1 Nonrecurring Inputs at Program Initialization

TEXT - TEXT is input from four punched cards punched in Columns 1 through 72. Subroutine PAGE prints TEXT as four lines of page header information.

ANLYIS - ANLYIS is input from a single card punched in Columns 1 through 18. Subroutine PAGE prints ANLYIS immediately to the right of the formatted statement:

ANALYSIS -

DATE - DATE is input from a single card punched in Columns 1 through 18. Subroutine PAGE prints DATE immediately to the right of the formatted statement:

DATE -

COSTIS AMULT - COSTIS states the problem scale factor in words that are printed out on every output page, AMULT gives the numerical value of the scale factor as a real number. It is used to convert all output cost data from dollars to some other convenient unit of output. It is used as a multiplier. Thus, for example, if AMULT is 0.001, COSTIS would be entered as THOUSANDS OF DOLLARS. COSTIS and AMULT are entered together on a single punched card. COSTIS is punched in Columns 1 through 36. AMULT is punched in Columns 42 through 51.

TOTAL - TOTAL is a nonrecurring input card which indicates that a summation of each LRU for all theaters is called. Individual LRUs in the input data for each case (theater) must be identically sequenced for the LRU summation to be meaningful. The number of distinct LRUs for which a total is to be taken over all cases in a concept must also be punched on the TOTALS card.

2.1.2 Recurring Inputs Which Must be Entered at Each Item (LRU) Input Cycle

UNITIS - UNITIS describes the current item (LRU) being entered. It is entered from a single card punched in Columns 1 through 18. Subroutine page prints UNITIS to the right of the formatted statement:

UNIT -

REMARK - REMARK is used in connection with UNITIS to record any qualifying information for the current item (LRU) under analysis. The qualifying information might include System No., Case No., theater, or other titles pertaining to a group of LRUs. REMARK is entered from a single card punched in Columns 1 through 72. Subroutine PAGE prints REMARK immediately below the prints of UNITIS.

2.1.3 Recurring Inputs Which are Entered Using NAMELIST/L/. All program inputs (Appendix B), except AMULT, are entered using NAMELIST/L/. It is the property of NAMELIST that any one or more of the variables appearing in the NAMELIST may be entered at the read of NAMELIST. At least one must be entered. Thus, at each input cycle for each new item (LRU), only the inputs which must be changed from the previous item need be entered. There are three considerations related to the deck structure for a case or system of LRUs:

a) The LOGAM model provides default values for inputs not entered. Thus, the analyst may start with little precise data and become more exact as the data base builds up. In the program, a BLOCK DATA subroutine initializes all inputs prior to the read of NAMELIST.

b) For a particular system of LRUs, there is generally a class of data which is common to all LRUs; these data need only be entered once with the first LRU of the system.

c) Finally, there are the LRU data such as those shown in Tables C-1, C-2, and C-7 which must be entered with each LRU provided that the value of the input changes between successive LRUs.

2.1.4 The Sample Problem Input Listing. Examination of the input listing shown in Appendix D indicates that the rules and sequence for structuring the input deck discussed in the three previous sections have been followed in setting up the sample problem input deck. First the header describing the analysis is shown as four lines of text. The next four cards designate the type of analysis, the date, the scale factor multiplier, and that LRU totals for both theaters are to be taken respectively. This is followed by the first LRU title card and the card which gives the case number, theater, and a summary of the LRU maintenance concepts.

Now the data for the first LRU in the NAMELIST format are given. This format requires that NAMELIST start with the characters &L and end with &END. This is characteristic of UNIVAC SPECTRA and IBM 360 computers. It is noted that the first LRU of the set contains many more punched cards than any of the subsequent LRUs since, as noted previously, the first LRU of a set contains all of the input data that are common to all or most of the LRUs which follow and these common data need only be input one time. Data inputs continue for each LRU of the first theater (USAREUR); the last LRU is Class 3 LRU No. 2. Then the data for CONUS follow and so on until the input data for all eleven LRUs in the system are entered.

This is followed by a set of punched cards for sensitivity testing to determine the effect of variation of failure rate. As discussed in Section 6, the sensitivity cards are punched as an input Array called SENSY in the NAMELIST format. The first element in the array called MODE designates the number of inputs being varied simultaneously. Thus, if MODE is one, only one input is being varied. The second element of SENSY called NPASS denotes the number of sets of variations being run. NPASS is the number of times that unit ND in the program will be rewound and reread. Thus for example, if two values of failure rate (E) are to

be run, the NPASS is two and the second element of SENSY is input as "2.,".

The remaining elements of SENSY are assigned in groups according to MODE. Each group is an ordered sequence of data and there are MODE entries in each group. The first group is a statement of the RULE to be used for assigning a value to each of the MODE variables for a particular SENSY run set. There are five RULES and the RULE number is a whole number from 1 to 5 inclusive. These RULES are stored in array 'NRULE."

The RULES are as follows:

a) To assign the value from SENSY to the input.
b) To add the value from SENSY to the input variable.
c) To subtract the value from SENSY from the input variable.
d) To multiply the input variable by the value from SENSY.
e) To divide the input variable by the value from SENSY.

The second group of entries, also of length MODE, is an ordered sequence designating the sequence numbers of the inputs included in the particular SENSY run set.

In the designation of the inputs for sensitivity testing, the program is structured to reference them by their numbered positional location in common block INPUT rather than by name. The numbered sequence for addressing LOGAM inputs to be sensitivity tested is given in Section 6.

The third group is the first set of values to be applied to the input variables. These values are assigned according to the set of "RULES" defined previously. There will be "NPASS" set of values. For example, the code designation for FNGF is 104 (Section 6), then the input $L SENSY=1, 2, 1, 104, 0, .2, 260x0, $ signifies that two passes of the variable FNGF will be run. On the first pass the value assigned will be zero and on the second pass the value 0.2 will be assigned.

Assignment is made in the main program where the values in core memory are altered after the data on unit ND are read into core memory. After the last pass, all elements of SENSY are set to zero. The baseline data set still resides on unit ND and at the next read of NAMELIST/L/, a new SENSY array can be input.

2.1.5 <u>The Basic Data Deck</u>. Referring back to the basic data deck shown in Appendix D , the USAREUR and CONUS input data decks are placed in series and the order of LRUs is identical for both theaters. This permits the use of the control NU = -3 to be tested to produce LRU printouts which are the sums of the previous LRU printouts for identical LRUs. The control NU = -3 also produces a GRAND TOTAL printout (the sum of all support costs for USAREUR plus all support costs for CONUS). Examination of the final LRU in the CONUS data set (Appendix D) shows the use of a card punched with the override value of NU = -3.

2.2 LRU Outputs

Tables C-8 and C-9 show the computer printouts for two individual LRU output pages obtained for the example problem. The results shown are for the final LRU (Class 3 LRU No. 2) of each scenario. Table C-8 is for the USAREUR scenario. Table C-9 shows the results obtained for the same LRU for the CONUS scenario. Output pages in this format can be obtained for each LRU in the data set depending on the value input for the control INHIB. The value INHIB = 1, when included with the LRU data deck, inhibits the printout of the LRU output page whereas INHIB = 0 allows printout of the LRU outputs as shown in Tables C-8 and C-9. For the examples shown, the cumulative totals are the case cost totals because the final LRU in each data set is used as the illustration.

Table C-10 shows the printout for supplemental information when policies are invoked which perform LRU repair at the equipment level. Table C-10 shows the result for Class 2 LRU No. 1 when policy GK is input.

2.3 Case and Grand Totals

Case cost total printouts for the USAREUR and CONUS scenarios are shown in Tables C-11 and C-12, respectively. The format for these presentations is the same as for the previous LOCAM 5 version of the program.

It is noted that the sample runs are based entirely on expected value (shared) manpower. If the run had been based on dedicated manpowwer in the field, the difference (DELTA) between dedicated and shared manpower costs would have been printed out near the bottom of the case totals pages.

Model availabiltities (CAYZ and CAYZI) are also printed out near the bottom of the page. In this instance, four sets of values are shown. The first set is the availability product for all eleven LRUs in the data set; the second is the availability product for the first four LRUs (Class 1 LRUs); the third is the product for all Class 2 LRUs; and the fourth is the product of the availabilities for the two Class 3 LRUs.*

Finally, printouts are included at the bottom of the page showing the hours per day of test equipment and repair service channel utilization and the number of men required for service channel operation at the various maintenance echelons.

*Note: The values input for the array TAYZ control this printout, for the sample problem:

TAYZ = 2*1., 8*0., is input with the first LRU (Class 1 LRU No. 1).
TAYZ = 1., 0., 1., 7*0, is input with the fifth LRU (Class 2 LRU No. 1).
TAYZ = 1., 2.0., 7*1, is input with the tenth LRU (Class 3 LRU No.1)

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
*MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A F NCTIONAL GROUP.*

UNIT - CLASS 3 LRU NO. 1
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS

ANALYSIS - THREE LRU CLASSES
DATE - JULY 1982

PRESENT VALUE COST TOTAL

EACH	CUM	
1705.	16184.	THOUSANDS OF DOLLARS

AVAILABILITY= .999763 INHERENT= .999934

PRIME	T.E.	TE SPACE	MANPOWER	SUPPLY	ORDERING	STORAGE	S.ADMIN	SHIPPING	TOTAL
0.	2.	0.	51.	1440.	2.	0.	207.	3.	1705.

PROVISION			INITIAL BUY			REORDER BUY			CONSUMED			RESIDUAL		
UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART	UNIT	MODULE	PART
18.	3.	2.	159.	162.	164.	20.	50.	100.	0.	0.	12.	18.	3.	0.

TEST EQUIPMENT AND REPAIR CHANNEL DATA

DIRECT				GENERAL				DEPOT			
T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM	T.E. EACH	CUM	EACH	REPAIR CUM
0.0000	0.0000	0.0000	0.0000	.0052	.0052	.0112	.0112	.0046	.0046	.0095	.0095
	0.0000		0.0000		.0268		.0401		.0536		.0804

ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS

DIRECT			GENERAL			DEPOT		
T.E.	TE MEN	REP MEN	T.E.	TE MEN	REP MEN	T.E.	TE MEN	REP MEN
0.	0.	0.	1.	0.	0.	1.	0.	0.
0.0000			.0058			.0050		

ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS

DEPOT		
T.E.	TE MEN	REP MEN
0.	0.	0.
0.0000		

EXPECTED VALUE MANPOWER AT EQUIPMENT, DIRECT AND GENERAL

PRESENT VALUE COST TOTAL

EACH	CUM						
1705.	16184.	MANPOWER	51.	DELTA	0.	PV DELTA	0.

INITIAL PROVISION QUANTITIES OF

	UNITS			MODULES			PARTS		
EQPT.	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT	DIRECT	GENERAL	DEPOT
0.	9.	9.	0.	0.	2.	1.	0.	0.	2.

COST OF INITIAL PROVISION

	EQPT.	DIRECT	GENERAL	DEPOT	TOTAL	RESIDUAL
UNIT	0.	249.	249.	0.	499.	499.
MODULE		0.	39.	19.	58.	58.
PART		0.	0.	0.	0.	0.

Table C-8. Results Obtained for Final USAREUR Scenario LRU

```
                              COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                               USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                                MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                                  ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 3 LRU NO. 2                                                                  ANALYSIS - THREE LRU CLASSES
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS                          DATE - JULY 1982


PRESENT VALUE COST TOTAL
EACH       CUM
    2775.      7852.     THOUSANDS OF DOLLARS               AVAILABILITY=  .999898  INHERENT=  .999915
PRIME     T.E.       TE SPACE MANPOWER  SUPPLY    ORDERING  STORAGE    S.ADMIN   SHIPPING  TOTAL
      0.      551.       0.        65.     2081.         1.         0.        73.        4.     2775.


PROVISION       INITIAL BUY        REORDER BUY          CONSUMED          RESIDUAL
UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART UNIT  MODULE PART
  16.     1.     1.   56.    57.    58.   20.    50.  100.    0.     0.    5.   16.     1.    0.


TEST EQUIPMENT AND REPAIR CHANNEL DATA
                   DIRECT                                        GENERAL                                DEPOT
     T.E.                              REPAIR     T.E.                               REPAIR     T.E.                                REPAIR
     EACH         CUM       EACH        CUM       EACH       CUM        EACH          CUM       EACH       CUM        EACH           CUM
   0.0000       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000      0.0000      .0063      .0063      .0211         .0211
                0.0000                0.0000                 .0051                  .0061                 .0272                   .0526


ROUNDED-UP TOTALS FOR TYPE I TEST EQUIP., CHANNELS
                 DIRECT                               GENERAL                              DEPOT
T.E.       TE MEN     REP MEN    T.E.       TE MEN     REP MEN    T.E.       TE MEN     REP MEN
   0.         0.         0.          0.         0.         0.          1.         0.         0.
0.0000                          0.0000                          .0070
ROUNDED-UP TOTALS FOR TYPE II TEST EQUIP., CHANNELS
                  DEPOT
T.E.       TE MEN     REP MEN
      0.         0.         0.
   0.0000


EXPECTED VALUE MANPOWER AT EQUIPMENT, DIRECT AND GENERAL

PRESENT VALUE COST TOTAL
EACH       CUM
    2775.      7d52.     MANPOWER        65.     DELTA          -0.     PV DELTA       -0.
INITIAL PROVISION QUANTITIES OF
                       UNITS                                                 MODULES                                           PARTS
   EQPT.       DIRECT    GENERAL         DEPOT          DIRECT     GENERAL      DEPOT            DIRECT      GENERAL          DEPOT
     0.           4.        12.            0.              0.          0.          1.               0.           0.              1.
COST OF INITIAL PROVISION                                                 RESIDUAL
        EQPT.         DIRECT        GENERAL        DEPOT         TOTAL
UNIT          0.         301.           903.           0.          1204.        1204.
MODULE                     0.             0.          33.            33.          33.
PART                       0.             0.           0.             0.           0.
```

Table C-9. Results Obtained For Final CONUS Scenario LRU

COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

UNIT - CLASS 2 LRU NO. 1
TOTAL

ANLYSIS - .THREE LRU CLASSES
DATE - JULY 1982

SUPPLEMENTARY INFORMATION REGARDING POLICIES GC, GI, GJ GK/

TEST EQUIPMENT AND REPAIR CHANNEL DATA
FOR EQUIPMENT LOCATED FACILITIES

T.E.		REPAIR	
EACH	CUM	EACH	CUM
.0001	.0001	.0001	.0001
	.0002		.0002

ROUNDED UP TOTALS FOR TYPE I TEST EQUIPMENT CHANNELS AT EQUIPMENT LOCATION

T.E.	TE MEN	REP MEN
141.	0.	0.
.0001		

INITIAL PROVISION QUANTITIES OF MODULES AT EQUIPMENT - 141.
COST OF INITIAL PROVISION MODULES AT THE EQUIPMENT - 4399.

Table C-10. LOGAM Output Format Showing Printout for Supplemental Information When Policies GC, GI, GJ or GK are Included

```
                    COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
                     USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                      MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                        ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES                                                              DATE - JULY 1982
                                                 CASE TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                               RECURRING COSTS
     INSTALLED EQUIPMENT                 0.
     TEST EQUIPMENT                   1517.                                       T.E. MAINTENANCE     360.
     TEST EQUIPMENT SPACE                0.                                  DEPOT SPACE/UTILITIES       0.
     MAINTENANCE MANPOWER              265.              FIELD        79.  DEPOT       175. TOTAL      254.
                                               TRAINING FIELD          5.  DEPOT         0. TOTAL        5.
     SUPPLY MATERIAL                  5469.                                               SUPPLIES    2325.
     REORDERING                          6.                                             REORDERING       6.
     MATERIAL STORAGE                    0.                                       MATERIAL STORAGE       0.
     SUPPLY ADMINISTRATION             585.                                  INVENTORY MANAGEMENT      462.
     SHIPPING AND HANDLING               9.                                               SHIPPING       9.

     GRAND TOTAL COST                 7852.                                        TOTAL RECURRING    3421.


     PRESENT VALUE                                                          COST OF INITIAL PROVISION
     DEVELOPMENT                         0.                                                  UNITS    2766.
     ACQUISITION                      4424.                                                MODULES     376.
     OPERATION AND MAINTENANCE        3427.                                                  PARTS       2.
     END LIFE SALVAGE                    0.                                        TOTAL PROVISION    3144.

     GRAND TOTAL                      7852.

EXPECTED VALUE MANPOWER AT EQUIPMENT DIRECT AND GENERAL

     MAINTENANCE MANPOWER              265.
     GRAND TOTAL COST                 7852.
     PRESENT VALUE
     OPERATION AND MAINTENANCE        3427.
     GRAND TOTAL                      7852.        DELTA        -0.          PV DELTA       -0.
```

Table C-11. LOGAM Printout Format For Case Cost Totals Page Showing Results Obtained for CONUS Scenario

```
          COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
           USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
            MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
              ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES                                                      DATE - JULY 1982
                                                 CASE TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                         RECURRING COSTS
     INSTALLED EQUIPMENT                0.
     TEST EQUIPMENT                  1531.                                T.E. MAINTENANCE      374.
     TEST EQUIPMENT SPACE               0.                           DEPOT SPACE/UTILITIES        0.
     MAINTENANCE MANPOWER             695.           FIELD     223.  DEPOT      444. TOTAL      667.
                                            TRAINING FIELD      13.  DEPOT        0. TOTAL       13.
     SUPPLY MATERIAL                 8496.                                        SUPPLIES     2841.
     REORDERING                        21.                                      REORDERING       21.
     MATERIAL STORAGE                   0.                                MATERIAL STORAGE        0.
     SUPPLY ADMINISTRATION            585.                            INVENTORY MANAGEMENT      462.
     SHIPPING AND HANDLING             11.                                        SHIPPING       11.

     GRAND TOTAL COST               11339.                                 TOTAL RECURRING     4390.

     PRESENT VALUE                                                    COST OF INITIAL PROVISION
     DEVELOPMENT                        0.                                           UNITS     5243.
     ACQUISITION                     6935.                                         MODULES      409.
     OPERATION AND MAINTENANCE       4404                                            PARTS        2.
     END LIFE SALVAGE                   0.                                 TOTAL PROVISION     5655.

     GRAND TOTAL                    11339.

EXPECTED VALUE MANPOWER AT EQUIPMENT DIRECT AND GENERAL

     MAINTENANCE MANPOWER             695.
     GRAND TOTAL COST               11339.
     PRESENT VALUE
     OPERATION AND MAINTENANCE       4404.
     GRAND TOTAL                    11339.          DELTA       -0.         PV DELTA       -0.
```

Table C-12. LOGAM Printout Format For Case Cost Totals Page
Showing Results Obtained for USAREUR Scenario

The format for the printout of GRAND TOTALS is shown in Table C-13. This printout gives the sums of all significant cost elements for the USAREUR plus CONUS scenarios.

2.4 Individual LRU Summary Totals

As discussed in Sections 4.3 and 7.1, LOGAM provides the versatility to sum up and print out the life cycle costs for two or more theaters of operation on an individual LRU basis. Table C-14, the printout obtained for Class 3 LRU No. 2, shows the summation of the costs for the USAREUR plus CONUS scenarios. Actually, Table C-14 is the composite of the results shown previously in Tables C-8 and C-9.

2.5 Sensitivity Listing Results

Included near the end of the input deck listing is the sensitivity NAMELIST input data set which was run with the baseline USAREUR and CONUS data sets. The structure of this data set is as discussed in Section 6 and as prepared for the CDC 6600 series computer. It consists of four cards. Two are leader cards, indicating that failure rate (Maintenance Incident Rate) is to be varied. The third card indicates the number of inputs to be varied, the number of passes, the rule to be used, the designation of the input variable and the changes to the baseline values to be investigated. The final card shows that INHIB and IFLAG are activated. These are input as unity to suppress the printouts of individual LRU pages and the summary totals LRU printouts. The results thus obtained are in the case totals and grand totals formats previously discussed (Tables C-9, C-11 and C-12). The case totals printouts are always preceded by a listing of the new values of the inputs identified by the designation number given in Section 6. Thus, the new value of the input/inputs assigned by activating the sensitivity test feature of LOGAM is always documented.

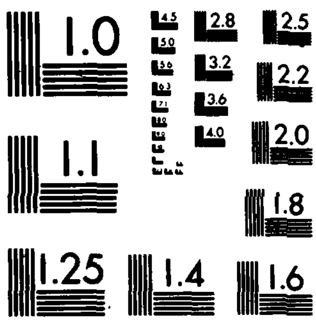
2.5.1 The Influence of Workload on Support Costs. The results obtained for the sensitivity runs made for the sample problem were used to construct the plots shown in Figures C-2 and C-3. Figure C-2 shows the effect of varying maintenance incident rate for the CONUS scenario, the USAREUR scenario, and the summation of the two deployments. Ten-year support costs are plotted as functions of maintenance incident rate multiple where the latter factor is a multiplier on the input data element E. The baseline value of unity reflects the support costs obtained for the basic values of E given in Table C-1. A maintenance incident rate multiple of two produces support costs associated with double the basic values of the input data element E.

Another way of viewing the same result is to plot support costs versus the inverse of maintenance incident rate. This was done to obtain the results shown in Figure C-13 which plots support costs versus MTBMA. Here, the curves display the characteristic "knee" as the time between maintenance actions increases.

AD-A136 801 LOGAM (LOGISTIC ANALYSIS MODEL) VOLUME 2 USERS MANUAL 3/3
(U) SPARTA INC HUNTSVILLE AL AUG 82
USAMICOM-DA-SR-D-82-2-VOL-2 DAAH01-82-P-0886

UNCLASSIFIED F/G 9/2 NL

END
DATE
FILMED
2-84
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

```
        COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
         USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
          MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
            ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

ANALYSIS - THREE LRU CLASSES                                                       DATE - JULY 1982
                                                 GRAND TOTAL
COST TOTALS, COST IN THOUSANDS OF DOLLARS                                          RECURRING COSTS
     INSTALLED EQUIPMENT                0.
     TEST EQUIPMENT                  7072.                                  T.E. MAINTENANCE      681.
     TEST EQUIPMENT SPACE               0.                             DEPOT SPACE/UTILITIES        0.
     MAINTENANCE MANPOWER             875.              FIELD      371.  DEPOT      463. TOTAL      834.
                                               TRAINING FIELD       22.  DEPOT        0. TOTAL       22.
     SUPPLY MATERIAL                22369.                                          SUPPLIES     9330.
     REORDERING                        30.                                        REORDERING       30.
     MATERIAL STORAGE                   0.                                  MATERIAL STORAGE        0.
     SUPPLY ADMINISTRATION           2010.                              INVENTORY MANAGEMENT     1605.
     SHIPPING AND HANDLING             46.                                          SHIPPING       46.

     GRAND TOTAL COST               32402.                                   TOTAL RECURRING    12548.


     PRESENT VALUE                                                       COST OF INITIAL PROVISION
     DEVELOPMENT                     3619.                                             UNITS     6616.
     ACQUISITION                    16216.                                           MODULES     6417.
     OPERATION AND MAINTENANCE      12567.                                             PARTS        6.
     END LIFE SALVAGE                   0.                                   TOTAL PROVISION    13039.

     GRAND TOTAL                    32402.

EXPECTED VALUE MANPOWER AT EQUIPMENT DIRECT AND GENERAL

     MAINTENANCE MANPOWER             875.
     GRAND TOTAL COST               32402.
     PRESENT VALUE
     OPERATION AND MAINTENANCE      12567.
     GRAND TOTAL                    32402.        DELTA        -0.        PV DELTA       -0.
```

Table C-13. LOGAM Printout Format for Grand Totals Page Showing Summation of USAREUR Plus CONUS Case Totals

```
              COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
               USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
                MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
                   ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
ANALYSIS - THREE LRU CLASSES
                                                                         DATE - JULY 1982
COST TOTALS, COST IN THOUSANDS OF DOLLARS     GRAND TOTAL
     INSTALLED EQUIPMENT             0.                                  RECURRING COSTS
     TEST EQUIPMENT               7118.
     TEST EQUIPMENT SPACE            0.                          T.E. MAINTENANCE      727.
     MAINTENANCE MANPOWER         2265.                 DEPOT SPACE/UTILITIES            0.
                                             FIELD   1022.  DEPOT    1136. TOTAL     2158.
     SUPPLY MATERIAL             31078.   TRAINING FIELD  60.  DEPOT    0. TOTAL       60.
     REORDERING                     96.                               SUPPLIES     10733.
     MATERIAL STORAGE                0.                             REORDERING        96.
     SUPPLY ADMINISTRATION        2010.                       MATERIAL STORAGE         0.
     SHIPPING AND HANDLING          53.                  INVENTORY MANAGEMENT      1605.
                                                                      SHIPPING        53.
     GRAND TOTAL COST            42620.
                                                               TOTAL RECURRING     15432.

     PRESENT VALUE
     DEVELOPMENT                  3619.                  COST OF INITIAL PROVISION
     ACQUISITION                 23522.                                  UNITS     13186.
     OPERATION AND MAINTENANCE   15479.                                MODULES      7149.
     END LIFE SALVAGE                0.                                  PARTS        10.
                                                               TOTAL PROVISION     20345.
     GRAND TOTAL                 42620.

EXPECTED VALUE MANPOWER AT EQUIPMENT DIRECT AND GENERAL

     MAINTENANCE MANPOWER         2265.
     GRAND TOTAL COST            42620.
     PRESENT VALUE
     OPERATION AND MAINTENANCE   15479.
     GRAND TOTAL                 42620.       DELTA      -0.        PV DELTA      -0.
```

Table C-14. LOGAM Printout Format For Individual LRU Summary Totals Page Showing Summation of USAREUR Plus CONUS Costs for Class 3 LRU No. 2

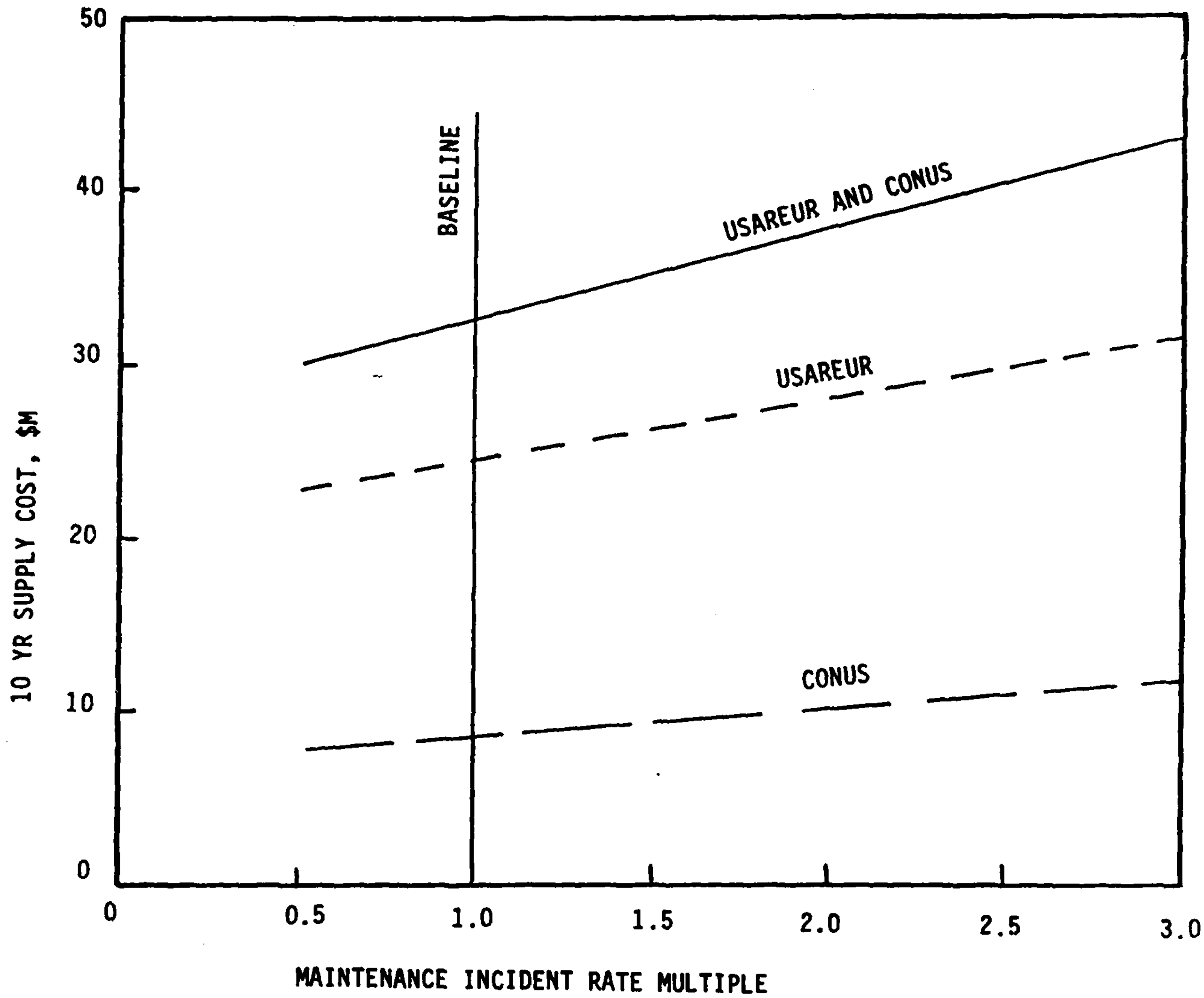


Figure C-2. Effect of Maintenance Incident Rate Variation.

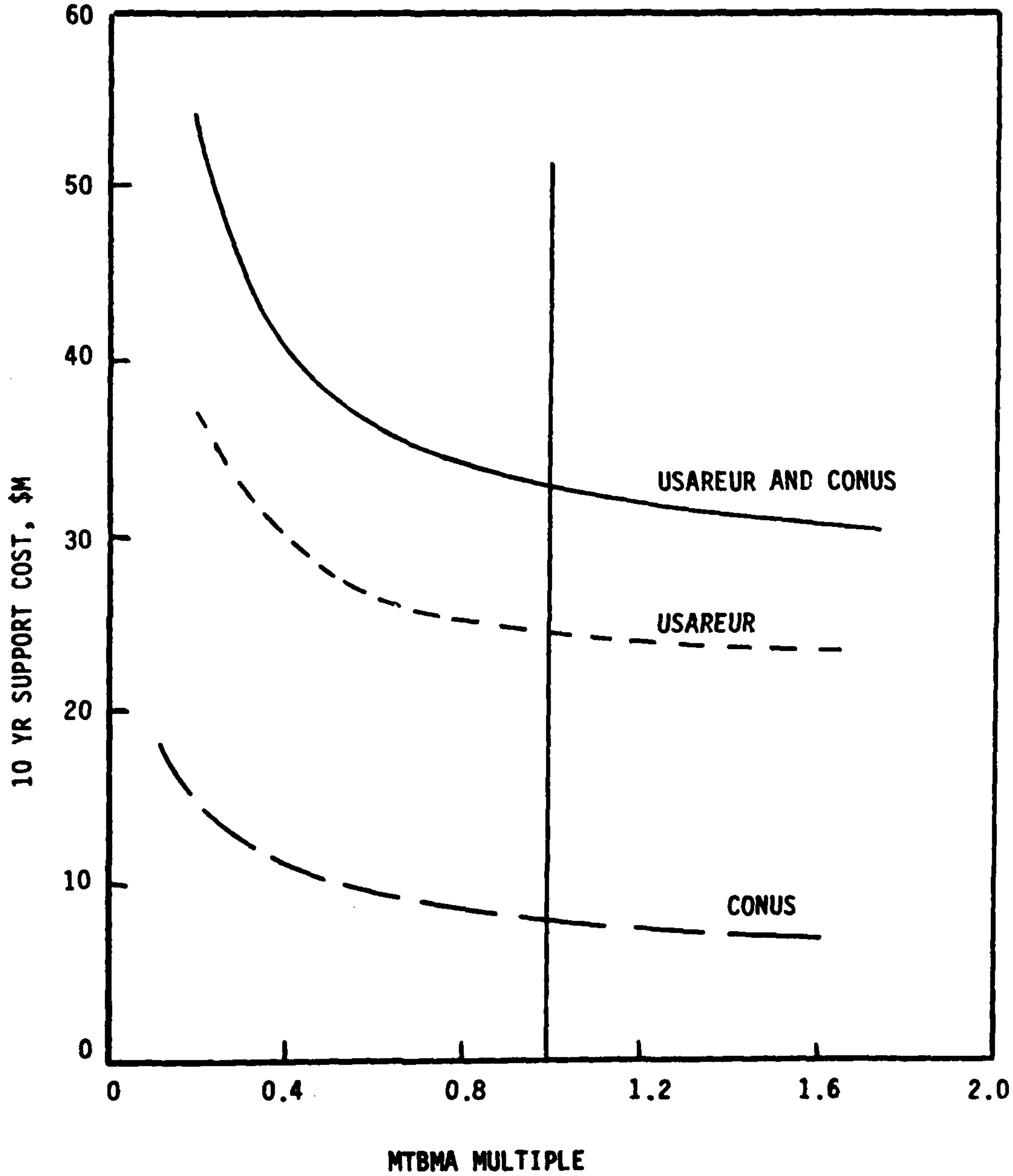


Figure C-3. Effect of MTBMA Variation

2.5.2 The Versatility Provided by the Built-in Sensitvity Test Feature. The examples shown in the previous section and in Section 7.2.3 indicate the versatility of LOGAM. The sensitivity test feature of LOGAM represents a powerful tool for the evaluation of logistic support alternatives. Practically any input variable or combination of variables can be varied through any range of values during any computer run. The use of the technique makes it possible to evaluate multiple effects on logistics cost and effectiveness very rapidly through the application of a carefully planned run set.

2.6 Sequenced Listing of Input Data

A feature of LOGAM which greatly facilitates examination of inputs is the printout of a sequenced listing of all input data factors. This section of the program is activated by inputting the value IO = 3, as was done with the final LRU for the CONUS scenario in the sample problem. This caused the printout of a formatted listing of all of the inputs used for the sample problem. Eight pages of computer printout resulted to provide coverage of the entire sequence of sample problem inputs (eleven LRUs and two scenarios) or twenty-two values for each input data factor. Samples of three of the pages of sequenced input printouts are shown in Table C-15.

2.7 Operating and Support Cost Output Format

As mentioned previously (Paragraph 1.2 of this Appendix and Section 5), LOGAM can be used to generate operational costs based on the TOE for a particular organization in a particular theater of operations. The format for the operational and support cost output is shown in Table C-16.

Table C-15. Selected Samples of LOGAM Printout Format for Listing of Sequence of Input Data for Example Problem Entire Input Data Set

	ARA	ARAD	AYZP	CAD	CALMAN	CALPUB	CALSET	CCAL	CCALP	CCALR	CCSP
1CLASS 1 LRU NO. 1	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
2CLASS 1 LRU NO. 2	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
3CLASS 1 LRU NO. 3	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
4CLASS 1 LRU NO. 4	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
5CLASS 2 LRU NO. 1	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
6CLASS 2 LRU NO. 2	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
7CLASS 2 LRU NO. 3	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
8CLASS 2 LRU NO. 4	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
9CLASS 2 LRU NO. 5	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
10CLASS 3 LRU NO. 1	.40	0.00	0.00	436.	0.	0.	0.00	0.	0.	0.	0.
11CLASS 3 LRU NO. 2	.40	0.00	0.00	436.	0.	0.	1.00	0.	220000.	2000.	425000.
12CLASS 1 LRU NO. 1	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
13CLASS 1 LRU NO. 2	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
14CLASS 1 LRU NO. 3	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
15CLASS 1 LRU NO. 4	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
16CLASS 2 LRU NO. 1	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
17CLASS 2 LRU NO. 2	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
18CLASS 2 LRU NO. 3	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
19CLASS 2 LRU NO. 4	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
20CLASS 2 LRU NO. 5	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
21CLASS 3 LRU NO. 1	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.
22CLASS 3 LRU NO. 2	.40	0.00	0.00	170.	0.	0.	0.00	0.	0.	0.	0.

	CCSPP	CCSPR	CDDI	CDEO	CDFD	CDIO	CDIO	CDIST	CDMAN	CDOE	CDOI
1CLASS 1 LRU NO. 1	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
2CLASS 1 LRU NO. 2	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
3CLASS 1 LRU NO. 3	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
4CLASS 1 LRU NO. 4	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
5CLASS 2 LRU NO. 1	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
6CLASS 2 LRU NO. 2	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
7CLASS 2 LRU NO. 3	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
8CLASS 2 LRU NO. 4	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
9CLASS 2 LRU NO. 5	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
10CLASS 3 LRU NO. 1	0.	0.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
11CLASS 3 LRU NO. 2	100000.	1000.	0.00	0.00	0.00	0.00	0.00	.60	16600.	0.00	0.00
12CLASS 1 LRU NO. 1	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
13CLASS 1 LRU NO. 2	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
14CLASS 1 LRU NO. 3	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
15CLASS 1 LRU NO. 4	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
16CLASS 2 LRU NO. 1	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
17CLASS 2 LRU NO. 2	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
18CLASS 2 LRU NO. 3	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
19CLASS 2 LRU NO. 4	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
20CLASS 2 LRU NO. 5	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
21CLASS 3 LRU NO. 1	0.	0.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00
22CLASS 3 LRU NO. 2	100000.	1000.	0.00	0.00	.33	0.00	0.00	.30	16600.	0.00	0.00

	CDPMAN	CDPRMN	CDRMAN	CEMAN	CEN	CEND	CERMAN	CFTD	CGMAN	CGRMAN
1CLASS 1 LRU NO. 1	26100.	26100.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.
2CLASS 1 LRU NO. 2	26100.	26100.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.
3CLASS 1 LRU NO. 3	26100.	26100.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.
4CLASS 1 LRU NO. 4	26100.	26100.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.
5CLASS 2 LRU NO. 1	16600.	16600.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.
6CLASS 2 LRU NO. 2	1660C.	16600.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.
7CLASS 2 LRU NO. 3	16600.	16600.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.
8CLASS 2 LRU NO. 4	16600.	16600.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.
9CLASS 2 LRU NO. 5	16600.	16600.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.
10CLASS 3 LRU NO. 1	1660C.	16600.	16600.	16600.	1077.	0.	16600.	1.00	16600.	16600.

	DTE	DTI	DTO	E	EACAL	EACSP	ED	EDS	EF	EKEI	ETE
1CLASS 1 LRU NO. 1	6.	60.	60.	.0001000	0.	0.	141.	141.	1.	1.00	1.00
2CLASS 1 LRU NO. 2	6.	60.	60.	.0001000	0.	0.	141.	141.	1.	1.00	1.00
3CLASS 1 LRU NO. 3	6.	60.	60.	.0005000	0.	0.	141.	141.	1.	1.00	1.00
4CLASS 1 LRU NO. 4	6.	60.	60.	.0005000	0.	0.	141.	141.	1.	1.00	1.00
5CLASS 2 LRU NO. 1	6.	60.	60.	.0021000	0.	0.	141.	141.	1.	1.00	1.00
6CLASS 2 LRU NO. 2	6.	60.	60.	.0017000	0.	0.	141.	141.	1.	1.00	1.00
7CLASS 2 LRU NO. 3	6.	60.	60.	.0011000	0.	0.	141.	141.	1.	1.00	1.00
8CLASS 2 LRU NO. 4	6.	60.	60.	.0010000	0.	0.	141.	141.	1.	1.00	1.00
9CLASS 2 LRU NO. 5	6.	60.	60.	.0008000	0.	0.	141.	141.	1.	1.00	1.00
10CLASS 3 LRU NO. 1	6.	60.	60.	.0010000	0.	0.	141.	141.	1.	1.00	1.00
11CLASS 3 LRU NO. 2	6.	60.	60.	.0013000	1.	1.	141.	141.	1.	1.00	1.00
12CLASS 1 LRU NO. 1	6.	30.	30.	.0001000	0.	0.	40.	40.	1.	1.00	1.00
13CLASS 1 LRU NO. 2	6.	30.	30.	.0001000	0.	0.	40.	40.	1.	1.00	1.00
14CLASS 1 LRU NO. 3	6.	30.	30.	.0005000	0.	0.	40.	40.	1.	1.00	1.00
15CLASS 1 LRU NO. 4	6.	30.	30.	.0005000	0.	0.	40.	40.	1.	1.00	1.00
16CLASS 2 LRU NO. 1	6.	30.	30.	.0021000	0.	0.	40.	40.	1.	1.00	1.00
17CLASS 2 LRU NO. 2	6.	30.	30.	.0017000	0.	0.	40.	40.	1.	1.00	1.00
18CLASS 2 LRU NO. 3	6.	30.	30.	.0011000	0.	0.	40.	40.	1.	1.00	1.00
19CLASS 2 LRU NO. 4	6.	30.	30.	.0010000	0.	0.	40.	40.	1.	1.00	1.00
20CLASS 2 LRU NO. 5	6.	30.	30.	.0008000	0.	0.	40.	40.	1.	1.00	1.00
21CLASS 3 LRU NO. 1	6.	30.	30.	.0010000	0.	0.	40.	40.	1.	1.00	1.00
22CLASS 3 LRU NO. 2	6.	30.	30.	.0013000	0.	1.	40.	40.	1.	1.00	1.00

	ETEI	ETI	ETII	EVDP	EVOR	EVOT	EVEP	EVER	EVET	EVIM	EVIR
1CLASS 1 LRU NO. 1	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
2CLASS 1 LRU NO. 2	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
3CLASS 1 LRU NO. 3	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
4CLASS 1 LRU NO. 4	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
5CLASS 2 LRU NO. 1	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
6CLASS 2 LRU NO. 2	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
7CLASS 2 LRU NO. 3	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
8CLASS 2 LRU NO. 4	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
9CLASS 2 LRU NO. 5	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
10CLASS 3 LRU NO. 1	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
11CLASS 3 LRU NO. 2	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
12CLASS 1 LRU NO. 1	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
13CLASS 1 LRU NO. 2	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
14CLASS 1 LRU NO. 3	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
15CLASS 1 LRU NO. 4	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
16CLASS 2 LRU NO. 1	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
17CLASS 2 LRU NO. 2	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
18CLASS 2 LRU NO. 3	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
19CLASS 2 LRU NO. 4	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
20CLASS 2 LRU NO. 5	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
21CLASS 3 LRU NO. 1	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.
22CLASS 3 LRU NO. 2	1.00	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.

	EVIT	EVOM	EVOR	EVOT	FE	FI	FII	FINT	FMD	FMI	FMO
1CLASS 1 LRU NO. 1	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
2CLASS 1 LRU NO. 2	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
3CLASS 1 LRU NO. 3	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
4CLASS 1 LRU NO. 4	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
5CLASS 2 LRU NO. 1	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
6CLASS 2 LRU NO. 2	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
7CLASS 2 LRU NO. 3	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
8CLASS 2 LRU NO. 4	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
9CLASS 2 LRU NO. 5	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
10CLASS 3 LRU NO. 1	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
11CLASS 3 LRU NO. 2	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
12CLASS 1 LRU NO. 1	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
13CLASS 1 LRU NO. 2	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
14CLASS 1 LRU NO. 3	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
15CLASS 1 LRU NO. 4	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
16CLASS 2 LRU NO. 1	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00

Table C-15. (Continued)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.08	.10	.10	0.00	1.00	1.00	1.00
18CLASS 2 LRU NO. 3	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
19CLASS 2 LRU NO. 4	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
20CLASS 2 LRU NO. 5	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
21CLASS 3 LRU NO. 1	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00
22CLASS 3 LRU NO. 2	0.	1.	0.	0.	.08	.10	.10	0.00	1.00	1.00	1.00

	FN	FNGF	FNSP	FSA	FTI	FTII	FTM	FTP	FTU	FUD	FUE
1CLASS 1 LRU NO. 1	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
2CLASS 1 LRU NO. 2	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
3CLASS 1 LRU NO. 3	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
4CLASS 1 LRU NO. 4	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
5CLASS 2 LRU NO. 1	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
6CLASS 2 LRU NO. 2	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
7CLASS 2 LRU NO. 3	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
8CLASS 2 LRU NO. 4	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
9CLASS 2 LRU NO. 5	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
10CLASS 3 LRU NO. 1	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
11CLASS 3 LRU NO. 2	0.	.20	.50	0.00	0.0	0.0	38.	20.	64.	1.00	1.00
12CLASS 1 LRU NO. 1	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
13CLASS 1 LRU NO. 2	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
14CLASS 1 LRU NO. 3	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
15CLASS 1 LRU NO. 4	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
16CLASS 2 LRU NO. 1	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
17CLASS 2 LRU NO. 2	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
18CLASS 2 LRU NO. 3	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
19CLASS 2 LRU NO. 4	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
20CLASS 2 LRU NO. 5	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
21CLASS 3 LRU NO. 1	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00
22CLASS 3 LRU NO. 2	0.	.20	.50	0.00	0.0	0.0	30.	12.	56.	1.00	1.00

	FUI	FUD	GA	GB	GC	GD	GE	GF	GG	GH	GI
1CLASS 1 LRU NO. 1	1.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
2CLASS 1 LRU NO. 2	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
3CLASS 1 LRU NO. 3	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4CLASS 1 LRU NO. 4	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5CLASS 2 LRU NO. 1	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6CLASS 2 LRU NO. 2	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7CLASS 2 LRU NO. 3	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8CLASS 2 LRU NO. 4	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9CLASS 2 LRU NO. 5	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10CLASS 3 LRU NO. 1	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11CLASS 3 LRU NO. 2	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12CLASS 1 LRU NO. 1	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13CLASS 1 LRU NO. 2	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14CLASS 1 LRU NO. 3	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15CLASS 1 LRU NO. 4	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16CLASS 2 LRU NO. 1	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17CLASS 2 LRU NO. 2	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18CLASS 2 LRU NO. 3	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19CLASS 2 LRU NO. 4	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20CLASS 2 LRU NO. 5	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21CLASS 3 LRU NO. 1	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22CLASS 3 LRU NO. 2	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	GJ	GK	GL	GM	GN	GO	GP	GQ	GR	GS	GT
1CLASS 1 LRU NO. 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2CLASS 1 LRU NO. 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3CLASS 1 LRU NO. 3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4CLASS 1 LRU NO. 4	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5CLASS 2 LRU NO. 1	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6CLASS 2 LRU NO. 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.85	.15
7CLASS 2 LRU NO. 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.85	.15
8CLASS 2 LRU NO. 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.85	.15
9CLASS 2 LRU NO. 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.85	.15
10CLASS 3 LRU NO. 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.70	.30

Table C-15. (Continued)

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COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.

SYSTEM MAINTENANCE SUPPORT COSTS

		COST	PERCENTAGE
1.000	RESEARCH AND DEVELOPMENT		
1.010	DEVELOPMENT ENGINEERING	3619.00	100.00
TOTAL		3619.00	100.00
2.000	INVESTMENT COST		
2.010	NON-RECURRING INVESTMENT	0.00	0.00
2.050	DATA	0.00	0.00
2.080	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
2.090	INITIAL SPARES AND REPAIR PARTS	20345.25	88.01
2.11	OTHER	2772.00	11.99
TOTAL		23117.25	100.00
3.000	OPERATING AND SUPPORT COST		
3.010	MILITARY PERSONNEL		
3.011	CREW PAY AND ALLOWANCES	0.00	0.00
3.012	MAINTENANCE PAY AND ALLOWANCES	1019.31	6.42
3.013	INDIRECT PAY AND ALLOWANCES	0.00	0.00
3.014	PERMANENT CHANGE OF STATION	0.00	0.00
3.020	CONSUMPTION		
3.021	REPLENISHMENT SPARES	533.00	3.36
3.022	PETROLEUM, OIL AND LUBRICANTS	0.00	0.00
3.023	UNIT TRAINING AMMUNITION AND MISSILE	0.00	0.00
3.030	DEPOT MAINTENANCE		
3.031	LABOR	1207.35	7.60
3.032	MATERIEL	245.77	1.55
3.033	TRANSPORTATION	4.18	.03
3.040	MODIFICATIONS MATERIAL	10603.77	66.76
3.050	OTHER DIRECT SUPPORT OPERATIONS		
3.051	MAINTENANCE, CIVILIAN LABOR	0.00	0.00
3.052	OTHER DIRECT	2106.24	13.26
3.060	INDIRECT SUPPORT OPERATIONS		
3.061	PERSONNEL REPLACEMENT	115.43	.73
3.062	TRANSIENTS, PATIENTS AND PRISONERS	0.00	0.00
3.063	QUARTERS, MAINTENANCE AND UTILITIES	0.00	0.00
3.064	MEDICAL SUPPORT	0.00	0.00
3.065	OTHER INDIRECT	48.61	.31
TOTAL		15883.67	100.00
GRAND TOTAL		42619.92	

Table C-16. Operating and Support Cost Output Format

APPENDIX D

SAMPLE DATA INPUT

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COMPARISON OF FIELD VERSUS DEPOT SUPPORT FOR SELECTED MICOM MISSILE LRUS
 USING LIFE CYCLE COST OF OWNERSHIP AND OPERATIONAL AVAILABILITY AS THE
  MEASURES OF EFFECTIVENESS. THE SYSTEM AVAILABILITY PRODUCT CONSIDERS
     ONLY THOSE LRUS WHICH OPERATE TOGETHER AS A FUNCTIONAL GROUP.
THREE LRU CLASSES
JULY 1982
THOUSANDS OF DOLLARS                          .001
   TOTAL                                                                11
CLASS 1 LRU NO. 1
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL OTF=.0548,E=.0001,P=3.,PP=20.,TIMW=.5,TDMW=.5,RDD=30.,WU=7.5,WM=.1,
 CKUI=.85,CKUO=.85,CKMO=.85,CKMI=.85,CKMD=.85,CKPD=.85,CKPI=.85,
 WP=.05,CUBEU=.12,CUBEM=.005,CUBEP=.003,COMAN=16600.,CORMAN=16600.,
 CGMAN=16600.,CGRMAN=16600.,WO=100.,WI=100.,WD=100.,ED=141.,ID=0,
 CTRA=2350.,ARA=.4,CSDEP=.1,DADOL=.98,CUP=988.,CMP=500.,CPP=3.,
 YMWO=.2,TMID=1.,TMDD=1.,CDPMAN=26100.,CDPRMN=26100.,ZI=0.,GT=1.,DTO=60.,
 CEN=1077.,CAD=436.,TMD=.8,TMDR=1.3,DI=2.,TDMAN=2.,TDRMAN=2.,DTI=60.,
 TOI=17.,TIO=0.,TDI=60.,TID=30.,NU=1,IS=3,CKIT=148.,TAYZ=2*1.,8*0.,NA=4,
 FTU=64.,FTM=38.,FTP=20.,CRU=835.,CRM=835.,CRP=835.,NTKIT=1.,TUMO=336.,
 WOM=40.,WIM=40.,WDM=40.,WOR=40.,WIR=40.,WDR=40.,YD=1.,YP=1.,YR=10.,
 TUMO=0.,INHIB=0,YZ=-1.5,CFTD=1.,QMU=20.,QMM=50.,QMP=100.,CKUD=.85,
 CKPD=.85,TGMAN=2.,TGRMAN=2.,TDPMI=2.,TDPRI=2.,TDPMII=2.,TDPRII=2.,
 FI=.1,FII=.1,OD=9.,ODS=9.,FNSP=.5,EVDR=0.,EDS=141.,FNGF=.2,DIS=2.,
 AYZP=1.,RID=30.,ROI=17.,SMD=0.,SMI=0.,SUD=0.,SUI=0.,TATE=3.,TOE=2.,
 SL=15.,15.,30.,TAT=15.,30.,127.,HPM=30.,HPP=30.,HPU=30.,ZU(1)=.5,
 CKUE=.85,CKME=.85,RED=17.,OL=15.,15.,15.,30.,OST=15.,15.,15.,30.,
 DTE=6.,SL=1.5,1.5,1.5,3.,TAT=1.5,1.5,1.5,3.,
 CEMAK=16600.,CERMAN=16600.,TE=1.,TER=1.,TEMAN=2.,TERMAN=2.,
 TRC=1.,TUMI=0.,YAT=0.,H=4*1.,OL=15.,15.,30.,OST=15.,15.,30.,STAT=60.,
 TATE=30.,STAT=30.,
 TATE=60.,
 GT=0.,
 AYZP=0.,
 CDIST=.6,
 GC=1. $
CLASS 1 LRU NO. 2
CASE I-USAPEUR REPAIP CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL ID=0,E=.0001,CUP=988.,CMP=500.,WP=.1,CUBEP=.005,TMD=.6,TMDR=1.1,
 WU=4.5,WM=.2,CUBEU=.15,CUBEM=.015,P=3.,PP=30.,CPP=2.5,GI=1.,GC=0.,
 $
CLASS 1 LRU NO. 3
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL E=.0005,P=2.,WP=.1,TI=.25,TIR=.5,TD=.25,TDR=.5,TMD=.5,TMDR=.9,
 WU=3.,WM=.5,CUBEU=.1,CUBEM=.01,CUBEP=.005,CUP=988.,CMP=500.,PP=20.,
 CPP=7.,GI=0.,GJ=1.,
 $
CLASS 1 LRU NO. 4
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL E=.0005,P=2.,PP=0.,TI=.25,TIR=.5,TD=.25,TDR=.5,TMD=0.,TMDR=0.,
 WU=3.,WM=.5,WP=0.,CUBEU=.1,CUBEM=.01,CUBEP=0.,CMP=450.,CPP=0.,
 CUP=741.,GT=1.,CKIT=111.,GT=0.,GI=0.,GJ=1.,
 $
CLASS 2 LRU NO. 1
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL E=.0021,ZI=.5,PP=50.,WU=40.,WM=2.,WP=.1,CUBEU=.75,CUBEM=.02,P=15.,
 TI=2.,TD=2.,TMD=.5,TMDR=.9,TDR=2.,TIR=2.,CUBEP=.005,CUP=57730.,
 TAYZ=1.,0.,1.,7*0.,
 CMP=2080.,CPP=12.5,ID=0,CDPMAN=16600.,CDPRMN=16600.,GJ=0.,GK=1.,
 CKIT=5773.,WTKIT=10.,
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CLASS 2 LRU NO. 2
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL E=.0017,PP=40.,TI=1.8,TD=1.8,P=10.,CMP=1126.,CPP=18.,TIR=1.5,WU=26.,
 IBG=0,
 CKIT=1761.,
 WM=1.5,WP=.08,CUBEU=.7,CUP=17613.,TMD=.5,TMDR=.9,TDR=1.5,GS=.85,GT=.15,GK=0.,
 $
CLASS 2 LRU NO. 3
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL E=.0011,P=8.,TI=.5,TD=.5,WU=36.,WM=2.,WP=.1,CUBEU=.75,CPP=10.5,
 TMD=.4,TMDR=.8,CUP=18827.,PP=40.,CMP=1500.,GS=.85,GT=.15,CKIT=1883.,
 IBG=0,
 $
CLASS 2 LRU NO. 4
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL TI=.8,TIR=1.8,TD=.8,TDR=1.8,E=.001,TMD=.3,TMDR=.6,CUP=12250.,P=4.,
 WU=40.,WM=2.,WP=.1,CUBEU=.75,CUBEM=.02,CUBEP=.005,PP=40.,CMP=1360.,
 CPP=9.,GS=.85,GT=.15,CKIT=1225.,
 $
CLASS 2 LRU NO. 5
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL TI=1.,TIR=1.8,TD=1.,TDR=1.8,TMD=.1,TMDR=.4,WU=36.,CKIT=500.,
 CUP=5000.,P=4.,PP=40.,CMP=1000.,CPP=6.,E=.0008,
 CI=1824000.,CPI=131500.,CRI=6000.,ETI=1.,GS=.85,GT=.15,ID=0,
 $
CLASS 3 LRU NO. 1
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL EE=1.,E=.001,P=12.,PP=50.,TI=.5,TIR=1.6,TD=.5,TDR=1.6,TMD=.3,
 TMDR=.6,WU=30.,WM=1.5,WP=.08,CUBEU=1.,CUBEM=.05,CUBEP=.01,CUP=27716.,
 TAYZ=1.,2*0.,7*1.,
 CPI=0.,CRI=0.,
 CMP=1610.,CPP=6.,ID=0,   ZI=.7,GS=.7,GT=.3,DI=1.,CKIT=2772.,DIS=1.,
 $
CLASS 3 LRU NO. 2
CASE I-USAREUR REPAIR CL.1 LRUS AT DEPOT-CL.2 LRUS AT DS-CL.3 LRUS AT GS
 SL NU=-1,IS=1,         ETII=1.,E=.0013,P=13.,PP=40.,TI=1.,IO=2,ID=0,
 CUBEU=15.,CUBEM=.5,CUBEP=.05,WP=.5,CII=1370000.,CRII=7500.,
 CI=0.,CPI=0.,CRI=0.,TMDR=3.4,CPP=11.,CPII=264000.,
 CCSP=425000.,CCSPP=100000.,              CCSPR=1000.,EACSP=1.,
 TD=1.,TMD=.75,CMP=2500.,TDR=3.5,TIR=3.5,WM=15.,CUP=75262.,WU=150.,
 EACAL=1.,CCALP=220000.,CALSET=1.,CCALR=2000.,ETI=1.,DI=1.,
 CONTCT=10.,
 ZI=.7,GS=.7,GT=.3,CKIT=7526.,WTKIT=30.,DIS=1.,
 $
CLASS 1 LRU NO. 1
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL  DTD=30.,DTI=30.,ED=40.,EDS=40.,OD=4.,ODS=4., DI=4.,DIS=4.,TDI=0.,TID=17.,
 TDI=30.,FTU=56.,FTM=30.,FTP=12.,DST(3)=20.,STAT=20.,CEN=451.,CAD=170.,
 GT=1.,
 CDFD=.33,CDIST=.3,
 $
CLASS 1 LRU NO. 2
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL ID=0,E=.0001,CUP=988.,CMP=500.,WP=.1,CUBEP=.005,TMD=.6,TMDR=1.1,
 WU=4.5,WM=.2,CUBEU=.15,CUBEM=.015,P=3.,PP=30.,CPP=2.5,GT=1.,
 $
CLASS 1 LRU NO. 3
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL E=.0005,P=2.,WP=.1,TI=.25,TIR=.5,TD=.25,TDR=.5,TMD=.5,TMDR=.9,
 WU=3.,WM=.5,CUBEU=.1,CUBEM=.01,CUBEP=.005,CUP=988.,CMP=500.,PP=20.,
 CPP=7.,GT=1.
 $
CLASS 1 LRU NO. 4
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL E=.0005,P=2.,PP=1.,TI=.25,TIR=.5,TD=.25,TDP=.5,TMD=0.,TMDR=0.,
```

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PP=0.,
CUP=741.,GT=1.,ID=2,CKIT=111.,IO=0,
$
CLASS 2 LRU NO. 1
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL E=.0021,ZI=.5,PP=50.,WU=40.,WM=2.,WP=.1,CUBEU=.75,CUBEM=.02,P=15.,
 TI=2.,TD=2.,TMD=.5,TMDR=.9,TDR=2.,TIR=2.,CUBEP=.005,CUP=57730.,
 TAYZ=1.,0.,1.,7*0.,
 CMP=2080.,CPP=12.5,GS=.85,GT=.15,CKIT=5773.,WTKIT=10.,
 $
CLASS 2 LRU NO. 2
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL E=.0017,PP=40.,TI=1.8,TD=1.8,P=10.,CMP=1126.,CPP=18.,TIR=1.5,
 WU=26.,WM=1.5,WP=.08,CUBEU=.7,CUP=17613.,TMD=.5,TMDR=.9,TDR=1.5,
 GS=.85,GT=.15,IO=0,CKIT=1761,
 $
CLASS 2 LRU NO. 3
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL E=.0011,P=8.,TI=.5,TD=.5,WU=36.,WM=2.,WP=.1,CUBEU=.75,CPP=10.5,
 TMD=.4,TMDR=.8,CUP=18827.,PP=40.,CMP=1500.,GS=.85,GT=.15,CKIT=1883.,
 $
CLASS 2 LRU NO. 4
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL TI=.8,TIR=1.8,TD=.8,TDR=1.8,E=.001,TMD=.3,TMDR=.6,CUP=12250.,P=4.,
 WU=40.,WM=2.,WP=.1,CUBEU=.75,CUBEM=.02,CUBEP=.005,PP=40.,CMP=1360.,
 CPP=9.,GS=.85,GT=.15,CKIT=1225.,
 $
CLASS 2 LRU NO. 5
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL TI=1.,TIR=1.8,TD=1.,TDR=1.8,TMD=.1,TMDR=.4,WU=36.,
 CUP=5000.,P=4.,PP=40.,CMP=1000.,CPP=6.,E=.0008,CKIT=500.,
 CI=0.,CPI=131500.,CRI=6000.,ETI=1.,GS=.85,GT=.15,
 $
CLASS 3 LRU NO. 1
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL E=.001,P=12.,PP=50.,TI=.5,TIR=1.6,TD=.5,TDR=1.6,TMD=.3,TMDR=.6,
 WU=30.,WP=1.5,WP=.08,CUBEU=1.,CUBEM=.05,CUBEP=.01,CKIT=2772.,
 TAYZ=1.,2*0.,7*1.,
 CPI=0.,CRI=0.,
 CUP=27716.,CMP=1610.,CPP=6.,ZI=0.,        GT=1.,
 $
CLASS 3 LRU NO. 2
CASE I-CONUS  REPAIR CL.1 AND CL.3 LRUS AT DEPOT-CL.2 LRUS AT DS
 SL NU=-1,IS=1,        ETII=1.,E=.0013,P=13.,PP=40.,TI=0.,WTKIT=30.,
 CUBEU=15.,CUBEM=.5,CUBEP=.05,WP=.5,CII=0.,CRII=7500.,CKIT=7526.,ID=2,
 CI=0.,CPI=0.,CRI=0.,ZI=0.,TMDR=3.4,CPP=11.,CPII=264000.,
 CCSP=0.,CCSPP=100000.,CONTCT=0.,CCSPR=1000.,EACSP=1.,ETI=1.,
 IO=3,
 NU=-3,
 CONTCT=5.,
 TD=1.,TMD=.75,CMP=2500.,TDR=3.5,TIR=3.5,WM=15.,CUP=75262.,WU=150.,GT=1.,
 $
SENSY ON FAIL RATE
FAILURE RATE IS  2- AND 3- TIMES BASELINE.
 SL SENSY=1.,2.,4.,81.,2.,3.,
 INHIB=1,IFLAG=1 $
END
FINIS
 SL NU=-4,IOPER=1, $
 STOE
 T=1.,1.,0.,5.,1.,0.,0.,0.,0.,29804.,
 1.,10.,0.,4.,1.,0.,0.,0.,0.,29804.,
 1.,13.,0.,3.,1.,0.,0.,0.,0.,18718.,
 1.,16.,0.,3.,0.,0.,1.,0.,0.,14038.5,
 1.,8.,0.,2.,1.,0.,0.,0.,0.,21057.75,
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1.,1.,0.,2.,0.,0.,0.,0.,1.,18718.,
1.,16.,0.,2.,0.,0.,1.,0.,0.,18718.,
1.,16.,0.,.5,0.,0.,0.,0.,1.,18080.,
1.,3.,0.,.5,1.,0.,0.,0.,0.,18080.,
1.,1.,1.,9.,1.,0.,0.,0.,0.,16759.,
1.,4.,1.,8.,1.,0.,0.,0.,0.,16765.75,
1.,4.,1.,8.,0.,0.,1.,0.,0.,16765.75,
1.,3.,1.,8.,0.,0.,0.,0.,1.,16759.,
1.,6.,1.,7.,1.,0.,0.,0.,0.,16759.,
1.,20.,1.,7.,0.,0.,1.,0.,0.,16759.,
1.,15.,1.,7.,0.,0.,0.,1.,0.,16759.,
1.,16.,1.,7.,0.,0.,0.,0.,1.,16759.,
1.,8.,1.,6.,1.,0.,0.,0.,0.,10469.,
1.,32.,1.,6.,0.,0.,1.,0.,0.,10469.,
1.,22.,1.,6.,0.,0.,0.,1.,0.,10469.,
1.,6.,1.,6.,0.,0.,0.,0.,1.,10469.,
1.,2.,1.,5.,0.,1.,0.,0.,0.,10469.,
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2,2,.112,17068,.112,17068,.036,.036,687,741,
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3,0,0,400,4,1.12,.0001,0,0,53,
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8.,0.,0.,0.,0.,0.,0.,0.,0.,0.,
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